THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVIII. No. 689.] LONDON, JULY 25, 1876. [28TH YEAR.] Price 6d.

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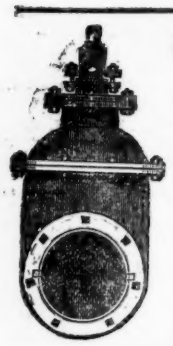
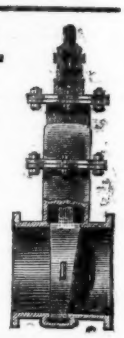
TELEGRAPH TUBES OR POLES, &c., &c.



C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

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By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

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1862.

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CLASS II.

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This Paint having been in general use over fourteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

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The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

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Attention is called to their Dry Meters in Wood Cases, as used by the principal London Gas Companies. These Meters are especially suitable for seaport towns and for export.

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Drawings and Prices upon application.

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Beg to call the attention of MANAGERS and DIRECTORS of GAS COMPANIES to the following letter which they have lately received.

COPY OF LETTER RECEIVED FROM MAGNUS OHREN, Esq.

To Messrs. John Wright and Co., Essex Works, Birmingham. *Crystal Palace District Gas Company, Lower Sydenham, S.E.*

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The Stoves you make I can with confidence recommend, having so many in use, and giving satisfaction. I need scarcely point out to you the advantage to Gas Companies to recommend the use of Gas Stoves to their Gas Consumers, even where they do not supply them on sale or rent, as the use of Gas Stoves brings day consumption, andt hus the Company make a profit by day as well as by night.—I am, dear sirs, yours faithfully, MAGNUS OHREN.

Size, 25½ in. high; 14 in. wide; 12½ in. back to front.

Price 50s., complete with Pan and Gridiron.

GAS HEATING STOVES

(TERRA COTTA AND IRON).

THE CHEERFUL STOVE.

COOKING STOVES.

BREAKFAST COOKERS.

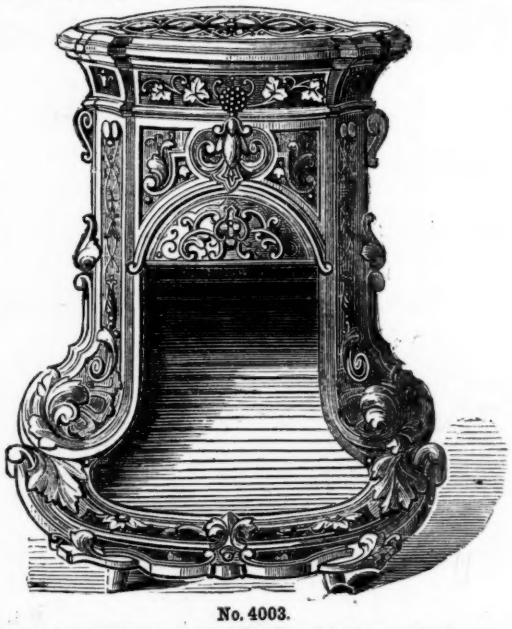
BATHS HEATED by GAS

GAS STOVES

For Boiling, Broiling, Preserving, Heating Flat Irons, and for all other Domestic Purposes.

Gas Companies and the Trade who have not our Illustrated Catalogue are respectfully requested to apply for same.

A LIBERAL DISCOUNT to the TRADE.



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THE CHEERFUL GAS STOVE, with Copper Reflector,

Has all the appearance of a Bright Fire.

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From "THE JOURNAL OF GAS LIGHTING," Jan. 5, 1875.

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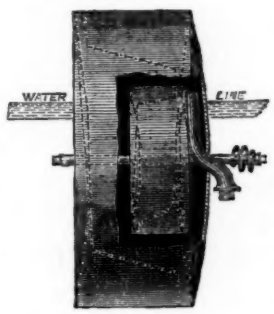

BRITISH ASSOCIATION of GAS MANAGERS, Leeds, 1875.

Inaugural Address of the President, JAMES PATERSON, Esq., F.G.S., of Warrington.

"There are, however, degrees of what may properly be termed excellence; and this leads me to notice one of the most beautiful applications which science has yet devised in the construction of the meter, and which has rendered it an absolutely reliable and unvarying instrument. . . . The object aimed at, and most admirably accomplished, is to change the varying measurement of a varying water-line to an unvarying measure with a varying water-line and annulus."

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"SELF-REGULATING DRUM" GAS-METER.

It is the ONLY Meter in which reliance can be placed.

It is the ONLY Meter in which the DRUM or WHEEL has been improved since it left the hands of Clegg and Crosley.

It is the ONLY Meter that POSSESSES AN UNVARYING MEASURING-CHAMBER.

It is the ONLY Meter FREE FROM delicate and complex compensating arrangements for maintaining water-line.

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W. & B. COWAN'S large and increasing Export Trade is provided for by their keeping constantly on hand a very large stock of both Wet and Dry Meters, ready for immediate despatch to the British Colonies and Foreign Countries.

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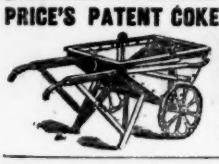

effecting a great saving of time, labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

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MANUFACTURE EVERY DESCRIPTION OF

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ALSO,

WROUGHT-IRON TUBES & FITTINGS.

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J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

Communications addressed to J. SUGG & CO., GHENT, will receive immediate attention.

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Owner of the Works at which Fire-Clay Retorts were first made), can supply

RETORTS, FIRE-BRICKS, &c.,

to any extent.

References can be given to managers of above a hundred Gas-Works whom he supplies.

He ships at Charlestown his

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DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for

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And every Description of Gas Apparatus.

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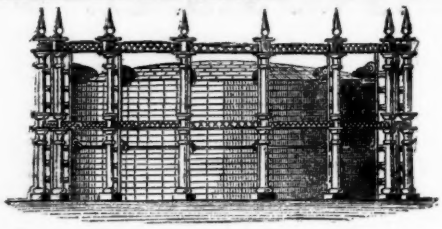

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GAS APPARATUS OF EVERY DESCRIPTION,

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Retort-Lids, Boilers, Cast and Wrought Iron Tanks, Iron Roofing, Bridges, Girders,

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WAS AWARDED, AT THE

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AT LILLE—GOLD MEDAL - - - 1874. AT MANCHESTER—SILVER MEDAL - 1874.

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"The simplest machine of its kind."—*Engineering.*

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"Nothing invented in hydraulic steam power half so cheap and effectual."—*Griffith's Iron Trade Exchange.*

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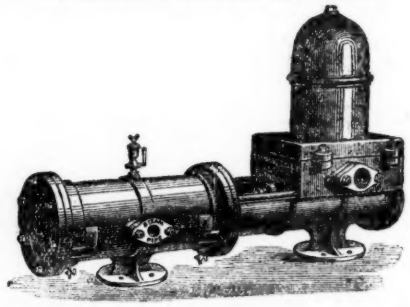

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THE PRINCIPAL GAS-WORKS IN LONDON, SHEFFIELD, PENISTONE, &c.,

FOR

TAR AND AMMONIACAL LIQUORS.

ONE SELECTED FROM AMONGST MANY TESTIMONIALS RECEIVED BY H. T. & CO.:—

"*Ardwick Bridge Chemical Works, Manchester, Oct.* 28, 1872.

"Sir,—The 'Universal' Steam Pump obtained from you, and which has been employed during the last six months pumping caustic soda at these works, still continues working satisfactorily,

"Yours truly,

(Signed) "PETER HART, *Manager.*"

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RETORT-LIDS,

WITH

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BRACKETED CROSS-BARS,

ANTI-FRICTION CATCHES, AND ECCENTRIC FASTENINGS.

NO LUTING.

NO DUPLICATE LIDS REQUIRED.

INSTANTANEOUS SEALING EFFECTED.

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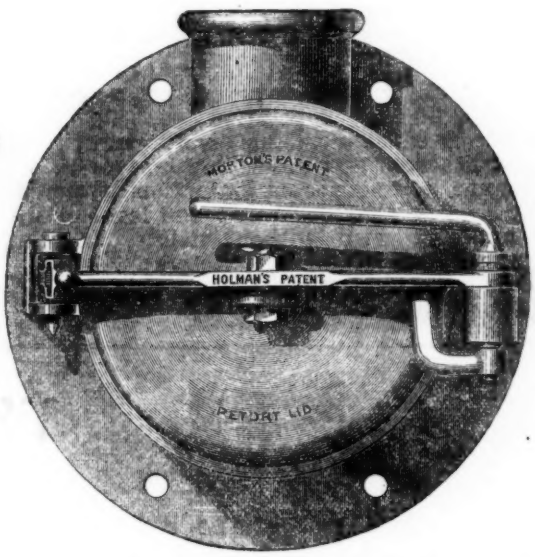

HOLMAN'S NEW SELF-SUSTAINING CROSS-BAR ENSURES FREEDOM OF JOINT, AND MAINTAINS PARALLEL POSITION OF THE LIDS.

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" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

The Gas-Works, Royal Arsenal, Woolwich.
" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
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" Rochdale do. do.
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" Windsor do.
" Leeds do.
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" Over Darwen do.
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IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them.

I should be very sorry to return to the old system of luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly,
(Signed) G. C. TREWEY.

London 1851. New York, 1853 Paris, 1855. London, 1862.

Dublin, 1865 Paris, 1867.

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DRY GAS-METER MANUFACTURERS,

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CONTENTS.

Circular to Gas Companies:— PAGE
Lord Camperdown's Amendment and its Consequence . . . 117
Withdrawal of the South Metropolitan Gas Bill . . . 117
Metropolis Gas (Surrey Side) Bill in Committee . . . 117
Metropolitan Board of Works and the Gas Question . . . 118
The London Gas Consumers League . . . 118
The Burghs (Scotland) Gas Supply Bill . . . 118
Mr. G. Livesey on Sulphur Purification . . . 118
The Gas Undertaking of the Wigan Corporation . . . 118
The Corporation of Newbury and the Gas Company . . . 118
Meeting of the North British Association of Gas Managers . . . 118
Water and Sanitary Notes:—
Pollution of Rivers Bill . . . 119
A Clean Rivers Bill . . . 119
Results of the Action of the Thames Conservancy Board . . . 119
Sir H. Cole, C.B., on House Drainage . . . 119
Leading Article:—
A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas . . . 119
Correspondence:—
Calculation of Cost Price of Gas to Public Lamps . . . 122
Parliamentary Intelligence:—
Progress of Bills in House of Lords . . . 122
The Gaslight and Coke Company and the South Metropolitan Gaslight and Coke Company Bills . . . 122
Progress of Bills in House of Commons . . . 122
Metropolis Gas (Surrey Side) Bill . . . 122
Pollution of Rivers Bill . . . 123
House of Commons Committee—Metropolis Gas (Surrey Side) Bill . . . 123
Miscellaneous News:—
Death of Mr. Wood, of Bury . . . 122
Compensation for Railway Injury to a Gas Manager . . . 122
Social Science Congress . . . 123
Gorleston and Southtown Gas Company . . . 123
Metropolis Gas Supply . . . 124
Metropolis Water Supply . . . 125
British Association of Gas Managers . . . 125
Wigan Corporation Gas-Works . . . 130
Reductions in the Price of Gas . . . 130
Wokingham Gas Company . . . 130
Analysis of Potable Waters . . . 130
On the Decomposition of Nitrate of Ammonia by Heat, and on the Volatility of Ammoniacal Salts. By M. Berthelot . . . 132
Berwick Gas Company . . . 132
Trade Reports . . . 133
Alfreton Water Supply . . . 134
Coal Contracts in France . . . 134
New Romney Gas Company, Limited . . . 134
Boston Gas Company . . . 134
Huddersfield Corporation Water Supply . . . 134
Register of New Patents:—
Bablon, V.—Gas and Fluid Regulators . . . 134
Stuttle, W.—Gas-Brackets . . . 134
Breeden, J.—Chandeliers and Gaseliers . . . 134
Southby, A. G.—Gas-Stoves . . . 134
Southby, A. G.—Supplying Stoves with Gas . . . 134
Hellier, H. G.—Lamps, &c. . . . 134
Pulford, G. C.—Glass Reflectors for Lamps . . . 134
Robertson, J.—Water-Meters . . . 134
Harries, B.—Gauging Supply of Water . . . 134
Spencer, T.—Purifying Water . . . 134
Murdoch, H. H.—Treating Spent Tan . . . 134
Willis and Pearson—Pumps, &c. . . . 134
Cook, H. W.—Purifying Hydrogen Gas . . . 134
Bonneville, H. A.—Preventing Breakage of Glass Chimneys . . . 134
Goddard, E.—Taps or Valves . . . 134
Jennings and Pocock—Liquid-Meters . . . 135
Rhames, R. W.—Gas-Burners . . . 135
Whitley, J.—Removing Sewer Gases . . . 135
Whitley, J.—Purifying Gas . . . 135
Gordon, J.—Stop-Cocks or Valves . . . 135
Hallsworth and Bailes—Purifying Gas . . . 135
Jameson and Schaeffer—Centrifugal Pumps . . . 135
Prior, M.—Pistons and Lubricants . . . 135
Wallace, J.—Pumping Water or Gases . . . 135
Clark, A. M.—Impelling or Forcing Air . . . 135
Tylor, A.—Controlling the Flow of Water . . . 135
Morgan-Brown, W.—Photometers . . . 135
Hughes, R. H.—Self-acting Valves . . . 135
Applications for Letters Patent . . . 135
Patents which have passed the Great Seal . . . 135
Patents which have become void . . . 135

NOTICE TO SUBSCRIBERS.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the second half of the year 1876, are reminded that this can only be done during the present month.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 25, 1876.

Circular to Gas Companies.

WE are now in possession of the amendment which the Earl of Camperdown intends to move, when the Bills of the Chartered and South Metropolitan Companies come before a full Committee of the House of Lords, and since it is of so much importance, we quote it here *in extenso*:—

For the purpose of estimating the value of the capital of the company in the event of the purchase of the undertaking, or any part thereof, by any public or local authority, whether by agreement or otherwise, the several descriptions of stock or shares in such capital shall, notwithstanding anything in this Act contained, be considered as entitled only to such maximum dividend as was authorized in respect thereof before the passing of this Act; and the stock or share capital raised under this Act shall, for such purpose as aforesaid, be estimated as entitled to a dividend not exceeding 10 per cent.

Now the purport and object of this amendment is perfectly clear. It is intended to deprive the shareholders of any advantage they might gain from the operation of the upward sliding scale whenever the companies are bought up, no matter by what authority. Frankly speaking, we are disposed to think that the shareholders in the Chartered Company will not be much prejudiced if the amendment be carried, for we have a fear that the upward scale will, in their instance, have but a limited application. But to the South Metropolitan shareholders, against whom, perhaps, it is aimed, the adoption of this amendment will entail serious consequences, more especially if the company should retain an independent existence until the day of purchase arrive. The policy of the directors of this company, and particularly of the younger members of the direction, has been dictated by a very natural desire to secure a high rate of dividend, with all the advantages which might be reasonably expected in the event of purchase. But this amendment, if carried, will blast all their hopes of obtaining better terms, when bought up, than other companies. They will be tied down inexorably to twenty-five years purchase of ten per cent. That is the reward they get for their ready acquiescence in the sliding scale, from the operations of which they expected so much.

Lord Camperdown was to have proposed his amendment on Friday evening last, but, in the absence of the Duke of Richmond and Gordon, it was postponed until to-day, and is now again put off until Thursday next. It is very unlikely that the Duke of Richmond will be in his place on the afternoon of the Goodwood Cup day; consequently, there may be a further postponement. These delays can hardly affect the position of the Bills immediately concerned. Whether the amendment be lost or carried, the Bills of the South Metropolitan and Chartered Companies will, unless withdrawn, pass this session. It is improbable that the latter company will withdraw their Bill, and, indeed, they have no reason to do so, since the amendment is of small consequence to them, and they must soon have money and land. But, to the former company, the matter is of very considerable importance, and the simple fact that the amendment is proposed, ought to decide them to withdraw their Bill. Indeed, we have reason to believe that the withdrawal has been determined upon, and the decision has not been arrived at, at all too early.

It must not, however, be supposed that we look upon the amendment as certain to be carried. Quite the contrary. We feel certain that it will be opposed by the Government, as a glaring infringement of private rights. It is, in fact, an audacious attempt to fix a price on property, irrespective of its commercial value. This never has been (speaking, of course, of modern times, since true commercial principles have been recognized), and we venture to think never will be done by a British Parliament.

We have, hitherto, referred only to the sliding scale as a means of adding to the value of gas property. But when the question of purchase is entertained, there will be another thing to be taken into consideration. As the Metropolis grows, gas business increases. On the lowest estimate, we may suppose that, in the course of the next ten years, the consumption of gas in the metropolitan district will be half as much again as it is to-day. Some consideration must, of course, be paid for this prospective increase. It may be said that Lord Camperdown's amendment does not touch this part of the question; for it is only an attempt to fix the value of share capital, and does not prohibit the payment of a consideration for prospective profits. We have, above, put that value, supposing the undertakings to be acquired to-day, at twenty-five years purchase of maximum dividends. But it may be regarded as certain, that a few years of business under the new legislation will, to some extent, increase the value of the share capital. The introduction of a considerable amount of non-dividend bearing capital, and a larger proportion of money borrowed at a low interest, must necessarily make dividends larger, more secure, and so enhance the value of shares. The old method of calculating the worth of share capital, then, can hardly hold good under the conditions that will presently obtain. We need not, however, enlarge on the question of purchase to-day. It may be deferred for years, and will be, if it should wait for the formation of a metropolitan municipality; or it may be imminent, if the Government should, in a certain event, make up their minds to support, and even introduce, a measure, something like that of Mr. Beal, which would place the metropolitan gas supply in the hands of a body of commissioners. The present Government are evidently inclined to the formation of new Boards and Commissions, and there is no knowing what may happen.

The proceedings at the first meeting of the Committee of the House of Commons on the Metropolis Gas (Surrey Side) Bill, which took place on Wednesday last, are reported in another column, and will be seen to be of a rather remarkable character. The House ordered the Committee to choose a chairman and proceed with the Bill. A chairman (Mr. W. E. Forster) was duly elected, but when it was proposed to proceed with the Bill,

the chairman interposed with a statement that the Bills named above were down for a full committee of the Lords on Friday, and that, as important alterations were proposed, he thought it would be better to wait the fate of the amendments. He accordingly suggested that the committee should adjourn until yesterday. But, as we have informed our readers above, Lord Camperdown's amendment will not be proposed until Thursday, and, therefore, the Commons committee cannot begin their sittings before Friday. That day is the 28th of July, and Parliament will be prorogued on the 12th or the 15th of August. It is clear that no Metropolis Gas (Surrey Side) Bill can possibly pass this session. The fault, of course, lies with the Board of Trade, who should have introduced their Bill earlier in the year.

There was something like a scene at the last meeting of the Metropolitan Board of Works. The weather is warm, and the gas question is exciting; hence, perhaps, a little disorder, which the mild chairman could hardly control, and which, under the circumstances, may be readily excused. Truth to say, the conduct of the Board on the gas question has not been consistent. They promoted a Regulations Bill (now in limbo), the great object of which was to ensure uniformity of initial price. Then they opposed uniformity. In a like manner they first opposed amalgamation on the south side, and subsequently, at the suggestion of the Board of Trade, they assented to a complete southern amalgamation. It is, then, no wonder that a few members, whose desire it is to keep the South Metropolitan Company isolated, should bring a charge of inconsistency against the majority. Nothing, however, was gained. A large majority of the Board decided to offer no opposition to the Surrey Side Bill, which is now altered so as to include the South Metropolitan Company in all its provisions. There will, then, if the Bill should pass, be nothing in the way of an amalgamation of the last-named company with others on the south side of the river, except the opposition of Camberwell and Lambeth, which would be useless. We have, however, expressed an opinion that the Bill is lost for the present session, and for that reason need not allude to other alterations proposed, the more so because we believe them to be amendments.

Thus the prospect of a settlement of the Metropolitan Gas Question this session again vanishes like morning dew. "As you "were," is the word of command, and we have to stand, not at all at ease, until we have another order from the Board of Trade fugleman. We do not care to prophesy, but it may be taken as certain that next year an attempt will be made to deal with the question in a broader and more comprehensive manner than any yet proposed.

There is, it seems, in London, a Gas Consumers League. Of whom the League is composed, we have no knowledge; but they would seem to be in funds, for they have expended some pence in foolscap and goose-quill, and have presented a petition to the House of Lords. Their intelligence, or rather want of it, may be gauged by the fact, that they pray that no further amalgamations of metropolitan gas companies may be sanctioned, and that the price of gas may be reduced. Amalgamation is the most certain way of bringing about a reduction of price, and just as it is extended and completed, so will the general consumer benefit. It is commonly said, and we may at once admit that, there is some truth in the statement, that amalgamations have not hitherto been beneficial to consumers. The simple reason is that the combinations were entered into at an unfortunate time. Given, a continuation of present rates for coal and iron, there can be no doubt that consumers will reap great advantage from further combinations of the gas companies.

Lord Redesdale, who, we should have mentioned before, will also propose amendments to the Bills of the Chartered and South Metropolitan Companies, has taken the Burghs (Scotland) Gas Supply Bill in hand, and has introduced some alterations which may be shortly noticed. On the whole, we think that the position of incorporated companies is made more secure, while that of the unincorporated is not further prejudiced. These latter are, of course, still liable to confiscation at the will of the ratepayers and the discretion of the sheriff. The consideration to be paid for the undertakings may be a lump sum or annuities, and with respect to these latter, his lordship has introduced what we rather think is a novel provision. Instead of being perpetual, the annuities are only to last forty years. For their redemption, and to provide for the repayment of borrowed money within the same period, the Commissioners of a burgh are required to set apart annually one-fortieth part of the sum borrowed, and also one-fortieth of the capitalized value, at twenty-five years purchase, of the annuities granted, which sums are to be lodged in a bank until applied to the purposes specified. To our minds, the provisions respecting the redemption of annuities are obviously imperfect, and require more consideration than Lord Redsdale has yet given to the matter.

We publish to-day the paper entitled "Sulphur Purification: "Is the Reduction of the Sulphur Compounds in Gas worth the "Cost and Trouble it Entails?" read by Mr. G. Livesey at the recent meeting of the Gas Managers Association. As we are somewhat at issue with the author on the question, we may make a few remarks. First of all, we may thank Mr. Livesey for the trouble he has taken in calculating the per centage weight of sulphur in relation to the weight of the gas from which it is obtained, but he must forgive us for saying that his figures, if not misleading, are, at all events, mystifying. Since gas is used by measure, it is much more intelligible to say that a hundred cubic feet contain so many grains of sulphur, notwithstanding the fact that the quantities are expressed under two different denominations. Mr. Livesey might just as well quarrel with the statement that a *gallon* of water contains so many *grains* of impurities, and ask to have the bulk of these impurities calculated. As regards the expense entailed by effective purification from sulphur, we can only say that if the public demand gas as free from sulphur as possible, they must pay the cost. If the Imperial Company had to spend £150,000 on plant, to carry out the requirements of the Referees, so much the better, we say, for the shareholders. Instead of moaning over the expenditure, Mr. Livesey should rejoice at it. The cost of lime and the disposition of the spent material is also paid by the public, whatever it may be. There is the nuisance, which is to some extent unavoidable, but which is so much under the control of the manager, that there need be scarcely any nuisance at all. The discomforts entailed by lime purification are, no doubt, great, and we are not insensible to them; but unfortunately, in this working world, men are continually called upon to risk their lives for a pound a week. Moreover, we have repeatedly seen men shed tears over the emptying of an oxide purifier. As regards the mischief done by sulphur in gas, we admit that it has been much exaggerated, but we regard the fact as indisputable. No amount of special pleading will controvert such facts as are recorded by Mr. Heisch in a report published in our issue for Dec. 29, 1874, to which, for shortness, we refer our readers. The pernicious effect of sulphur in gas, on health, we may say is, at all events, asserted. There is a physician in large practice in London, who ascribes most cases of spitting of blood, which come under his notice, to the inhalation of the sulphuric acid generated in the combustion of gas containing sulphur. Our space is exhausted, but we must say a word as to the future of sulphur purification. Mr. Livesey, like ourselves, entertains a very high opinion of Mr. Vernon Harcourt, regarding him as an eminent chemist, likely to settle the sulphur question. Well, Mr. Harcourt has recently told our readers that the process he has devised for the removal of sulphur is practicable, cheap, and effective. Why does not Mr. Livesey employ it, and so satisfy his customers, promote the comfort of his men, and save his company the cost of lime? It appears to us, to alter an expression used, but not written, by the author, that the "more emi-"nent the chemist," the *less* difficulty he sees in the way of sulphur purification.

The gas undertaking of the Wigan Corporation is, unfortunately, not a paying concern. The actual money loss sustained to June, 1875, was £6065 13s. 2d., and we see that the leakage of gas last year amounted to 35 per cent. of the make. This great loss arises from the fact that the district is everywhere undermined, and mains are continually breaking. The Corporation are now about to make an attempt to improve matters, and have applied for power to borrow £10,000, in order to relay and extend their mains, which, when done, it is hoped, will change the aspect of affairs.

We mentioned, a few weeks ago, that the lease of the land which the Newbury Gas Company hold from the Corporation is about to expire, and that a renewal is refused, the Corporation desiring to obtain possession of the undertaking. Negotiations for the transfer are, we believe, in progress. The history of gas enterprise in Newbury is curious and instructive. The first works were erected in 1825, on land leased by the Town Commissioners, for a term of twenty-one years, to Mr. Hedley, of London. At the expiration of that lease the Commissioners took over the works at a valuation, but, failing to make a profit, they in a short time sold the works to the present company, giving them a fresh lease of the land, which in 1864 was renewed for a further term of fourteen years, by a newly constituted town authority. In all this time the company have failed, or, rather, never attempted, to obtain statutory powers, which might have enabled them to secure the lands on which the works are situate, or acquire another site, in view of the present circumstances. The company are thus at the mercy of the existing authority, and their case may serve as a warning and caution.

We are sorry that we are not able to commence this week a report of the proceedings at the recent meeting, in Edinburgh, of the North British Association of Gas Managers. Mr. Mackenzie, the obliging Secretary to the Association, writes that some delay has

been caused by correspondence with members, but the report and papers will be furnished to us as early as possible. In the meantime, we may state that the meeting, under the presidency of Mr. S. Stewart, of Greenock, was very successful. The opening address of the President was full of interesting matter, to which, however, we cannot refer until we have a full report.

We are not surprised to find that reference was made at the meeting to some scandalous letters, purporting to emanate from coalmasters, which have recently appeared in the *Glasgow Herald*. We have never noticed the correspondence, because we always doubted its origin; but, supposing the worst allegations to be true, we quite agree with Mr. Watson in believing the bribing coalmaster to be much more culpable than the bribed gas manager.

Water and Sanitary Notes.

The Pollution of Rivers Bill has made but small progress, and will probably be finally disposed of for this session in another Herodian massacre, which will take place in a few days. It stood for second reading last night; but notice has been given of such a large number of amendments, that it can hardly be disposed of in one sitting, nor even in two; its fate, therefore, is very uncertain, but we expect it will be abandoned.

In addition to the above measure, we have now a Clean Rivers Bill, brought into the House of Lords by the Earl of Doncaster, the object of which is to preserve clean rivers in a state of cleanliness. The definitions in the Bill are somewhat vague. The term "river" includes lakes, ponds, streams, canals, and watercourses of every description; "a clean river," or "clean part of "a river," means any river as defined by this Act, or part of a river, in which the water is not affected by any extraneous polluting cause, to such an extent as to be materially deteriorated in quality; "polluting matter" includes any matter, whether solid or liquid, which, introduced into water, alters appreciably for the worse the quality of such water. The penalty for infringing the provisions of the Act, if it should pass, is a fine of £50 a day if the pollution be not summarily prevented on the order of a County Court Judge. It is not necessary to say more with reference to this Bill, of which, probably, nothing more will be heard.

A return, to an order of the House of Commons, has been furnished by the Thames Conservancy Board, showing the results of the notices given by the Board, requiring the discontinuance of the passing of sewage and other polluting matters into the Thames, above the intakes of the water companies. The paper seems to show that the upper part of the river will soon be free from fresh sewage pollution. All the large towns have works in progress, which will soon be completed, while the pollution from private establishments has almost entirely ceased, only a few people at Staines being still under notice. This is highly satisfactory, for it gives hope that, by the autumn of next year, when the Oxford sewage works will be completed, the river above the intakes will be quite free from fresh sewage. We do not expect to see any striking results in the Registrar-General's returns of deaths in consequence.

The authorities below the intakes have now to be dealt with by the Conservancy Board, and their treatment will require great firmness. Hardly one of them will do anything until they are absolutely compelled. Their conduct drives us reluctantly to the conclusion, that the best thing would be for the Local Government Board to bring forward a comprehensive scheme for the drainage of the valley from Hampton to the limits of the Metropolis, and appoint a body of Commissioners, under whose supervision the works shall be executed. As it is, the several Boards only stand in each other's way. Kingston and Surbiton, for example, agree to a joint scheme, and immediately Hampton Wick steps in and threatens opposition.

Sir Henry Cole, C.B., has rented a house in South Kensington, and soon after taking possession, discovered that the drains were not all right, and it cost him, it seems, £100 to put them in order. This is no uncommon experience; but, seeing that it happened to Sir Henry Cole, C.B., we have a meeting of that very fussy body, the Society of Arts, resulting in the appearance of a deputation of three at the last meeting of the Metropolitan Board of Works, with the modest request that the Board should undertake the inspection of all the house drains in the Metropolis. "Typhoid fever," Sir H. Cole, C.B., says, "is "chronic in South Kensington," and the cause he asserts to be "badly constructed drains." The demand of the memorialists was unreasonable and unnecessary, but we are not quite certain that more supervision might not be exercised by district surveyors with great advantage, and we hope the matter will not escape attention in the new Building Act the Board intend to promote next year, in which, too, we should be glad to see provisions inserted to compel sound and dry foundations, no less essential to health than properly constructed drains.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CI.

Specific Gravity of Coal Gas.

The specific gravity of properly purified coal gas has been found to bear a certain relation to the illuminating value, the richer the gas the greater being the density; while, on the contrary, the poorer the quality of the gas, the less its specific gravity. This arises from the fact that the illuminating power of purified gas is mainly dependent on the presence of those heavier hydrocarbons which, while increasing the lighting value of the gas, likewise increase its density. It must, however, be remembered that the presence of an abnormal quantity of carbonic oxide will give rise to a considerable increase in density, without the equivalent of increased value, and that specific gravity as applied to gas containing carbonic acid, sulphuretted hydrogen, or any appreciable quantity of atmospheric air, is, from the same cause, equally valueless.

There are three methods in practical use for ascertaining the specific gravity of coal gas, and we shall now describe them in rotation. The ordinary method, which is used by the practical chemist to obtain the specific gravity of gases in general, consists essentially in comparing the weight of a known volume of the gas under examination, with an equal volume of pure dry air, at the same temperature and pressure. Latterly, pure hydrogen has been adopted as the standard of comparison; but, inasmuch as all the known results relating to coal gas have been obtained by comparison with air, the present description will be confined to the method in which the specific gravity is deduced from the comparative weights of gas and air.

For this purpose a light glass globe, provided with a well-ground stop-cock, and which may conveniently have a capacity of about 200 cubic inches, is exhausted by means of an air-pump, and subsequently weighed by means of a suitable balance. The weight of the empty or vacuous globe is thus found. The globe is then attached to a long tube containing perfectly dry chloride of calcium, and the stop-cock partially opened, so that the globe is thus allowed to fill slowly with air. The calcic chloride entirely deprives the air of any aqueous vapour which it might contain, and allows nothing but perfectly dry air to enter the globe. When quite full the stop-cock is shut, and the weight of the globe is again taken, when the difference between the weight so obtained and that of the exhausted globe gives the weight of a globeful of dry air. The vessel being again exhausted, is allowed to fill with the gas under examination, the entering gas being made to pass slowly through the tube containing the calcic chloride, as before, and when full of gas, the globe is disconnected and weighed. The weight so obtained, after deduction of the weight of the empty globe, will give the weight of the gas. The specific gravity can then be found by dividing the weight of the gas by that of the air. The whole determination should, if possible, be conducted in a room possessing an equable temperature, and the exact temperature and pressure, as indicated by the thermometer and barometer at the time of making the experiment, noted. Any variation between the temperature or pressure of the gas and that of the air must be made the subject of correction, the means of calculating which will be given farther on. A more convenient globe apparatus for determining the specific gravity of coal gas is that figured in the adjoining diagram.

No air pump is required, as the weight of the globe, both in the vacuous condition, and likewise when filled with dry air at a normal temperature and pressure, is engraved on the glass, and much time and trouble is thus saved. In use, the globe is simply connected by its lowermost extremity to some gas-fitting, and the gas then allowed to pass through, making its escape by the brass nozzle, where it may be ignited. The gas, having been allowed to burn until the air has been entirely displaced, the lower stop-cock may be turned off, and subsequently the upper one. The globe is then unscrewed, disconnected from the tube containing the thermometer, and weighed. It is advisable to re-connect the globe, and, after passing gas for a short time, to disconnect and re-weigh, as, by this means, the identity of weight in the two cases will prove that the expulsion of the air has been complete, and that the data obtained are consequently accurate. When greater accuracy is desirable, the gas should be passed over calcic chloride before being admitted to the globe, in order to remove aqueous vapour. The thermometer attached to the globe, when in use, serves to indicate the temperature of the gas, and, as this is seldom exactly at the standard of 60° Fahr., it is necessary, for the sake of accuracy, to make a correction, as well as for any variation in the barometric pressure above or below the standard of 30 inches. Gases expand 1-480th of their volume for every additional degree Fahrenheit, or 1-273rd of their volume for every degree Centigrade, and the method by which gaseous correction for temperature is made may be best shown by an example. Let us suppose that, in a specific gravity experiment, the observed temperature was 70° Fahr., the weight of the gas being 31·5 gains; gas at 70° is obviously lighter than the same gas at the normal temperature of 60°. The difference between

70° and 60° is 10°, and the observed weight of the gas must, therefore, be increased by 10-480ths, which equals 1-48th = 0·65, which, added to 31·5, gives 32·1 as the corrected weight. This method of calculation, however, involves the use of fractions, and it is therefore simpler to state the question in the following way:—As 480, *plus* the difference between 32 and the standard temperature, is to 480, *plus* the difference between 32 and the observed temperature, so is the weight of the gas obtained to the corrected weight required—thus:

$$\begin{array}{cccccc} 508 & : & 518 & :: & 31{\cdot}5 & : & x \\ (480+28) & & (480+38) & & & & \end{array}$$

$x = 32{\cdot}1$ grains, the corrected amount.

The correction for pressure is founded on the law of Boyle and Dalton, "that the volume of a gas is inversely as the pressure to which it is subjected." Thus, supposing at the time of the experiment the barometer stood at 28, instead of being at the normal standard of 30 inches, then the calculation for correction would be expressed as follows:—

$$28 : 30 :: 32{\cdot}1 : x$$

$$x = 34{\cdot}4$$

We thus see that the volume of gas, which was found to weigh 31·5 grains when the temperature was 70°, and the barometer stood at 28 inches, gives a weight of 34·4 grains when corrected to the standard temperature and pressure. Both corrections can, if desired, be made in one sum in the following way:—

$$\frac{31{\cdot}5 + 518 + 30}{508 + 28} = 34{\cdot}4, \text{ the corrected weight.}$$

A table to facilitate gaseous corrections has been calculated by Regnault, and will be given hereafter. In using the table, it is only necessary to find the tabular number corresponding to the observed temperature and pressure, and divide the weight or volume of gas by the number so obtained, in order to get the corrected quantity. Thus, in the experiment already quoted, the tabular number for the observed temperature and pressure—viz., 70 and 28, would be ·915, and 31·5 ÷ ·915 = 34·4.

The second method of ascertaining the specific gravity of coal gas is that introduced some time since by Mr. Wright, of Westminster, and although it can by no means lay claim to great accuracy, is extremely useful and convenient for practical use. A light balloon, made of goldbeaters skin, and having a capacity of one cubic foot, is provided, with a small car attached, and a series of (so-called) grain weights, each of which has an absolute weight of 0·5356 grains, or the weight of the thousandth part of a cubic foot of air at the standard temperature and pressure. In making an experiment, the air contained in the balloon is first completely expelled by folding it closely up, in which condition its exact weight is ascertained by means of the weight supplied. The balloon is then completely filled with the gas to be examined, and becoming thus lighter than the surrounding atmosphere, it has a tendency to rise. Weights are then placed in the small car attached to the balloon, until the whole remains just suspended in air. The following rule will then indicate the true specific gravity of the gas corrected for any abnormal temperature or pressure. To the weight necessary to exactly counterpoise the balloon in air when filled with gas, add the weight of the empty balloon, deduct from the number so obtained the tabular number corresponding to the temperature and pressure of the *air* at the time of making the experiment, and divide by the tabular number corresponding to the temperature and pressure of the gas. The first three figures obtained indicate the specific gravity. The following example taken from Wright and Hartley's "Analysis of Gas for Practical Men" will show in detail the method of calculation employed:—

		Tabular No.
Temperature of the air	70°	932
Barometer	28·5	
Temperature of the gas	56°	958
Barometer, always the same as air . .	28·5	

Weight of Balloon and Grains in Car, 560.

932 tabular number for the air.
560 weight of balloon, &c.

Tabular No. for the gas, 958) 3720 (·388 specific gravity.
2874

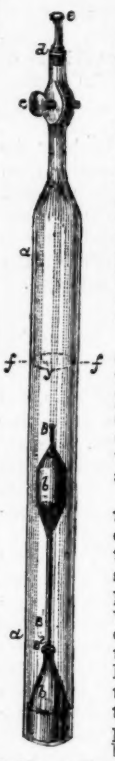
8460
7664

7960
7664

296

The third method of taking the specific gravity of gases is that known as "Bunsen's Effusion Test." As modified by Schilling, this process is, in practice, exceedingly convenient and accurate, and one of the greatest features of the method is that a determination of specific gravity can be taken with far less expenditure of gas, and in considerably less time than is occupied by either of the processes previously described.

The effusion test depends on the fact that when gases of various densities are allowed to flow from a minute orifice at a given pressure, the squares of the times taken in effusion represent the proportion between the specific gravities. The original effusion method of Bunsen, as described in "Bunsen's Gasometry," is as follows:—



The glass tube, *a a* (see diagram), has a capacity of about 70 cubic centimètres.* It is open at the bottom, and furnished at the top with a glass stopcock, *c*, to the upper portion of which the small glass tube, *e*, is ground, so as to form a gas-tight joint at *d*.

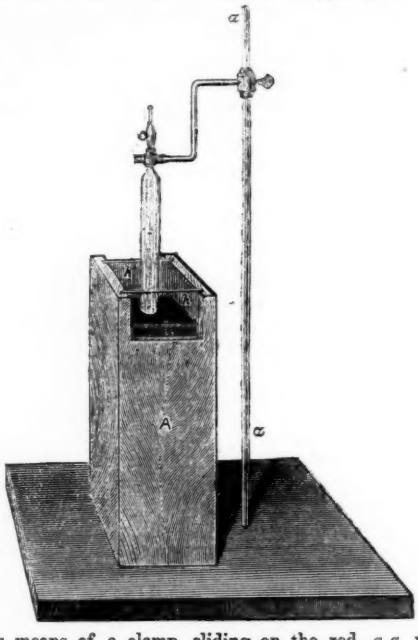
At the extremity of the tube, *e*, is a small piece of platinum foil, united to the glass by fusion at the blow-pipe, and perforated at the centre by an extremely fine orifice. This orifice is made, in the first instance, by puncturing the platinum with the point of a fine needle, and subsequently hammering the foil with a polished hammer on an anvil, until the hole is so small that light can only be seen through it when the foil is held directly between the eye and a bright flame. The small piece of foil is subsequently cut to a circular form, and fixed on to the extremity of the tube, *e*.

In order to facilitate accurate reading of the quantity of gas used in experiment, and likewise to provide for the issue of different gases under identical conditions of pressure, the tube, *a a*, is provided with a float, *b b*, constructed of light thin glass. At the upper extremity of the float, at the point B, is a small bead of black glass, which is surmounted by a small thread of white glass, and at B^1 and B^2 are two other threads of black glass.

In making an experiment, the tube, *a a*, with its contained float, is completely filled with the gas to be examined, and subsequently adjusted in the mercurial trough so that the mark *y* on the tube exactly corresponds with the outer level of the mercury. In this position the uppermost extremity of the float, *b b*, is not visible to a telescope directed to the point *y*. The stopcock is now opened, and the mercury slowly rises in the tube, *a a;* after a short time, during which the level of the mercury must be carefully watched through the telescope, the white thread attached to the top of the float becomes visible, giving warning of the approach of the black bead. At the moment the latter becomes visible, the time is noted by a clock, indicating half-seconds, and when the black thread, B^2, the approach of which will be indicated by the appearance of B^1, becomes visible, the time is again noted, and the observation is finished.

By this means the time of effusion is obtained of a column of gas of a constant length of from B^1 to B^2, and under conditions of pressure which are uniform for each experiment. The square of the effusion times of various gases gives the relation of the specific gravities.

The general arrangement of the effusion tube and mercurial trough is shown in the sketch. The tube is supported at the desired



height by means of a clamp, sliding on the rod, *a a*, while the upper part of two opposite sides of the mercurial trough, *h h*, is constructed of plate glass, in order that a direct view may be obtained of the level of the mercury and the rise of the float. The results obtained by this method are extremely accurate when due care is exercised; it is, however, always advisable, when possible, to repeat the experiment once or twice, and thus to obtain a mean result which will obviously give greater correctness than could be obtained by a single trial alone.

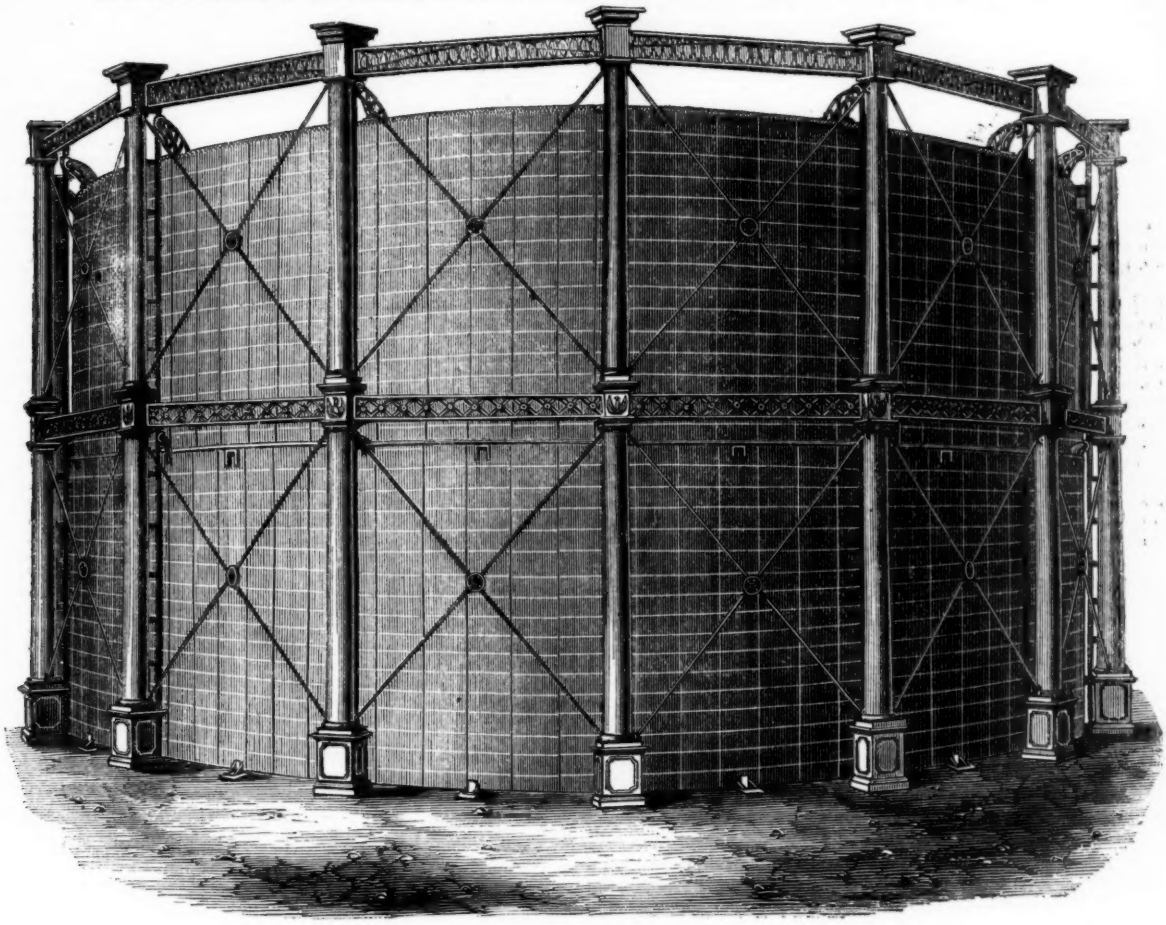
(To be continued.)

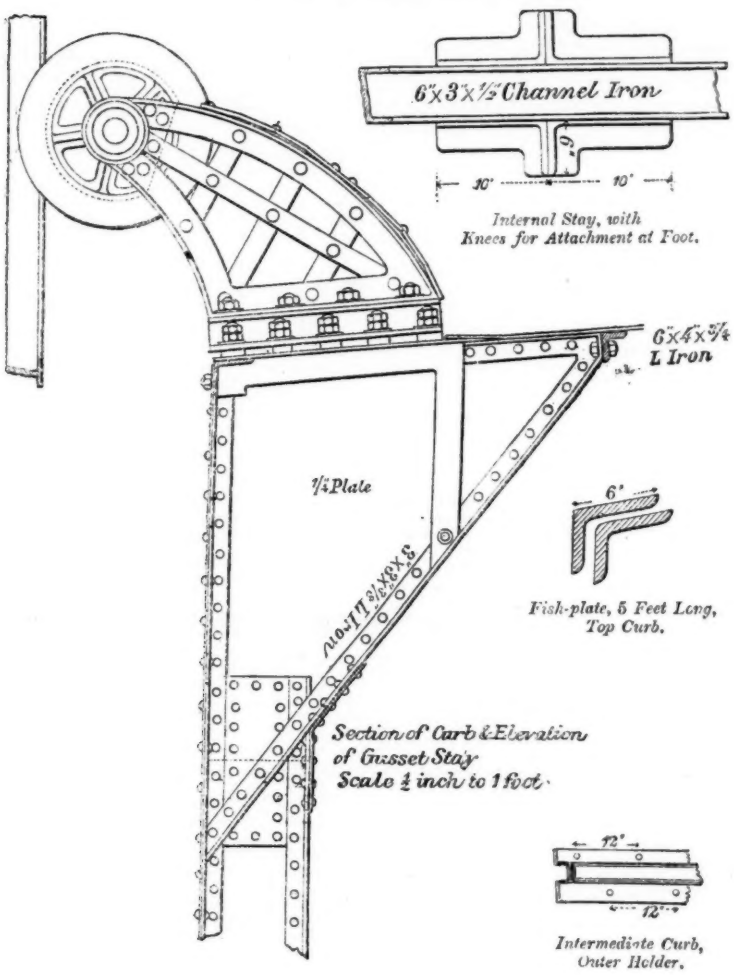
New Gasholder—Phœnix Gas Company.

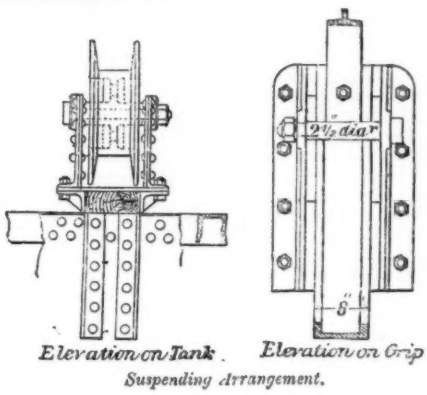
When closing our remarks on gasholders in the Journal for the 4th of January last, we promised to take an early opportunity of

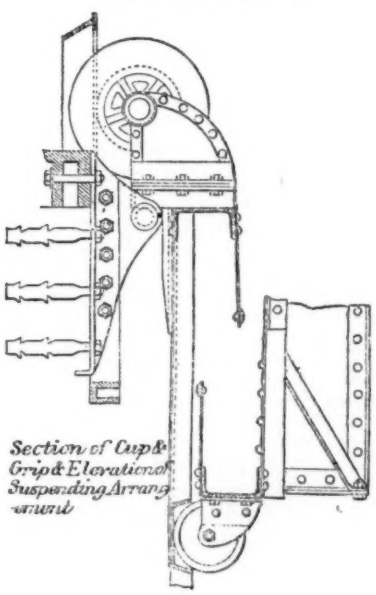
* Equal to a little over 4 cubic inches.

NEW GASHOLDER—PHŒNIX GAS COMPANY—KENNINGTON LANE. (C. WOODALL, *Engineer.*)









giving a description and drawing of a holder erected last year by Mr. Corbett Woodall, engineer of the Phœnix Gas Company, at the station of that company in Upper Kennington Lane, Lambeth. Although, through the courtesy of Mr. Woodall, the drawings have been finished for some months, we have been unable to redeem our promise until now.

Outer Holder.—The diameter of the outer lift of the holder is 139 feet, and the depth from top of the grip 36 feet. The top row of side sheets, forming the grip, are ¼ inch thick, the bottom row No. 7 B.W.G., and the intermediate rows No. 11 B.W.G. The lower curb is composed of angle-iron, 5 by 5 by ½ inch, and a bottom plate, 9 by ⅝ inch, the guide-rollers being attached between this curb and a piece of 6 by 4-inch angle-iron 2 feet long, rivetted to the side sheets above it. The intermediate curb is of bridge rail, weighing 25 lbs. per yard, rivetted to the side sheets by rivets, 12 inches apart, on each side. The cup and grip are formed of channel iron, 9 by 4½ by ½ inch, attached to sheets by a double line of ⅝-inch rivets, 2½ inches apart. The cup is 16 inches deep, and the plate forming the same and the grip are ¼ inch thick, and stiffened at their edges by a ring of 2½ by ⅜-inch half-round iron, rivetted to same by ⅝-inch rivets, 6 inches apart.

The internal stays are 32 in number; they are composed of channel iron, 6 by 3 by ½ inch, rivetted to sheets by ⅝-inch rivets, 12 inches apart. Knees of 3 by 3 by ½-inch angle-iron are attached, through the sheets, to the bottom curb, and similar knees, in reverse positions, rivetted to the stays. The weight of the stays is carried by this means before attaching them to the sheets.

In order to relieve the side sheets and vertical stays of the weight of the outer holder when at rest, which they are little able to bear, the holder is provided with an arrangement for suspending the same on the coping of the tank. This is done by the means of 32 brackets, bolted on to the tank guides, and to the stone coping of tanks, by ragged bolts. The brackets are formed of 4 by 4 by ⅝-inch angle-iron plates ⅜ inch thick, and a 2½-inch wrought-iron pin.

The guide carriages of the outer holder are formed of 3 by 3 by ½-inch angle iron, and project so as to rest on these brackets, a packing of hard wood being fixed between to take the bearing.

The points intermediate between the columns are fitted with a projecting cantilever similar to the lower portion of the guide carriage.

Mr. Woodall does not intend to carry the whole weight of the outer holder by these means, but to divide the weight between the rest-stones and the brackets. Any tendency of the side sheets to buckle would be met by the brackets taking an increased share of the load.

The Inner Holder.—This has a diameter of 136 feet 9 inches, and a height of 36 feet. The top row of side sheets are 5-16ths, the bottom row ¼ inch, and the remainder No. 11 B.W.G. The crown of holder has a rise of 3 feet in the centre, and is provided with three man-holes. The first row of roof sheets is ½ inch thick, with plane butt joints, covered by jointing pieces of 5½ by ⅝ inch; second row 5-16ths inch thick; the centre plate is 6 feet diameter, ⅜ inch thick, and the two rows adjoining same No. 7 B.W.G. Radiating from the centre rings to the outer rings are eight strips, 2 feet wide, No. 9 gauge; the remaining sheets are rectangular, of No. 11 gauge.

The vertical stays are formed of a web plate ¼ inch thick, 15 inches wide, and four angle-irons, 3 by 3 by ⅜ inch, rivetted together by ⅝-inch rivets 4 inches apart. At the top of each is a gusset plate 5 feet wide by 6 feet deep. The stays are rivetted both to top and side sheets, and are supported at bottom by angle-iron strap and sole plate. The gusset pieces are bolted to the top curb, and to a second ring of angle iron, 6 by 4 by ⅜ inch, at their inner edge.

The intermediate curb is of T-iron, 4 by 3 by ½ inch, rivetted at 12 inch distances to side sheets. All the joints of T, angle, and channel iron have the ends planed so as to butt truly together. All rivets are ½ inch diameter, and were rivetted hot.

Guide-Columns and Framing.—The guide-columns are 16 in number; they are 72 feet 6 inches high, and the shaft is 3 feet diameter at base, and diminished to 2 feet at top, the columns being each in eight pieces, the flanges inside, and the joints turned. The columns are braced together by two tiers of diagonal tie-rods 1¼ inch diameter, meeting in the centre in a ring formed of channel iron. The top girders are 2 feet 9 inches deep, the web of cast iron, and the flanges of angle-iron, 4 by 4 by ½ inch, the top flange having a plate 9 by ½ inch, and the bottom a similar plate 9 by ⅜ inch, the whole rivetted together with ⅝-inch rivets, 4 inches apart. The intermediate girders are 2 feet 6 inches deep angle-irons, 4 by 4 by ½ inch, top-plates 9 by ½ inch, and lattice-bars 3 by ½ inch. The columns are braced together at top with braces from alternate columns of 3 by ¾ inch flat iron, supported on a bracket fixed to the intermediate columns. The guide-bars are of T-iron, 5 by 5 by ⅝ inch, secured to the columns by cast saddle pieces.

Death of Mr. Wood, of Bury.—We have to record the death, on the 17th inst., at his residence, Bolton Street, Bury, of Mr. Joseph Wood, late manager of the Bury Gas-Works. Mr. Wood was one of the pioneers of the British Association of Gas Managers, was elected a member of the committee at the first general meeting in 1864, and held the office of vice-president for several years. He was also president of the Manchester District Association of Gas Engineers in 1870 and 1871. Mr. Wood's sterling character and genial disposition secured for him the esteem of all of his professional brethren. "To know him was to love him." He was in the 45th year of his age.

Compensation for Railway Injury to a Gas Manager.—At the Manchester Assizes, on Friday last, Mr. George Crook, late assistant gas manager to the Bolton Corporation, recovered damages £650 against the London and North-Western Railway Company for injuries received by him in a collision on their line at Atherton in February last.

Correspondence.

CALCULATION OF COST PRICE OF GAS TO PUBLIC LAMPS.

Sir,—I am still of opinion that my calculation stands correct, notwithstanding the kind remarks of your correspondent in the Journal of this date, and with pleasure I give a detailed statement of my general expenses; but, in the first place, allow me to inform him that he misquotes me. On reference, he will find the general expenses returned at £25 9s. 1d. (not, as he says, £29 5s. 1d.), and he is perfectly correct in his surmises when he states that I may have included lime under this heading. The fact is, that my lime account amounts to such a mere trifle annually, that I group it with the general expenses, rather than open a separate account; but, bless my soul! can your correspondent be serious when he mentions the sum of £18 as the probable cost of lime for purifying two and three-quarter million cubic feet of gas? Why, sir, this would work out to more than 1½d. per 1000 cubic feet, whereas it costs me only for lime, and I use nothing else, ½d. per 1000 to purify all the gas I make.

As to the next charge which he takes objection to, £96 19s. 2d. for repairs, I frankly admit that at first sight it seems high; but there are many things to be taken into consideration before passing judgment on this item. I will give you a case in point: Suppose, on taking charge of a works, you found it to be in a most dilapidated condition. I hold you would be justified in placing the works in perfect order (as I have done), charging the amount expended each year to revenue, and that the amount so expended is a fair and honest criterion whereby to calculate the cost price for that *particular year*. Now, sir, this is just the point in dispute between the Municipal Commissioners and myself, and upon which I hope to be favoured, through the columns of the Journal, with the opinion of some of my more privileged professional brethren; but permit me to say that although an Irishman, I lay no claim whatever to infallibility. Perhaps I was wrong, and should have charged my renewals to capital. However, in any case, I may tell your correspondent that it is long since I set my face against spreading expenses over a number of years. My practice is to take up a little at a time, and make every year defray its own expenses, experience having taught me that "sufficient unto the day is the evil thereof."

Detailed Statement of General Expenses.

Directors remuneration	£11	7	7
Printing, stationery, stamps, &c., &c.	7	3	6
Auditor's fee	1	1	0
Lime used in purifying gas	5	17	0
	£25	9	1

The only apology I can offer for trespassing so far on your valuable space, is to remind you once more of my nationality. R. A. G.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, July 17.

The Sevenoaks Gas Bill was read the third time, and passed.

Clean Rivers Bill.—This bill, for making further provision against the pollution of rivers hitherto free from pollution, was presented by the Earl of Doncaster, and read the first time.

THE GASLIGHT AND COKE COMPANY AND THE SOUTH METROPOLITAN GASLIGHT AND COKE COMPANY BILLS.

Lord Redesdale proposed (under Standing Order No. 141),—"That these bills be committed to a committee of the whole House."

This was agreed to, and Friday, July 21, was appointed for their consideration.

Thursday, July 20.

The Commons amendments to the Blackrod Gas Bill were considered, and agreed to.

Burghs (Scotland) Gas Supply Bill.—On the motion of the Earl of Galloway this bill passed through committee, an amendment having been made.

Friday, July 21.

A petition was presented from the Gas Consumers League and others, praying that no further amalgamation of metropolitan gas companies may be sanctioned, that their capital may be regulated, and the price of gas reduced.

The Gaslight and Coke Company and the South Metropolitan Gaslight and Coke Company Bills.—The committee which was appointed for this day was put off to Thursday next, July 27.

HOUSE OF COMMONS.

Monday, July 17.

The Lords amendments to the Dewsbury and Heckmondwike Water, the Lancaster Water and Improvement, and the South Hants Water Bills were agreed to.

The Blackrod Gas Bill (Lords) was read the third time, and passed, with amendments.

METROPOLIS GAS (SURREY SIDE) BILL.

Petitions against this bill were presented from the South Metropolitan Gas light Company and the Phœnix Gaslight and Coke Company.

On the motion of Sir Charles Adderley, Mr. Garnier, Mr. Goulding, and Mr. Stevenson were nominated members of the select committee; and it was ordered—"That the minutes of evidence taken before the committee on the Metropolis Gas Companies Bill, the Commercial Gas Company's Bill, and the Imperial Gas Company's Bill in 1875, be referred to the committee on the Metropolis Gas (Surrey Side) Bill of the present session."

The Committee of Selection added Mr. W. E. Forster and Mr. Tremayne to the select committee.

Wednesday, July 19.

The Lords amendments to the Oldbury Local Board of Health Bill were agreed to.

Metropolis Gas (Surrey Side) Bill.—Mr. Tremayne was discharged from, and Mr. Richard Bright (Somerset) was added to the committee on this bill.

Thursday, July 20.

The Lords amendments to the Newcastle and Gateshead Water Bill were agreed to.

Metropolis Gas (Surrey Side) Bill.—On the motion of Mr. W. E. Forster it was ordered—"That the parties appearing before the select committee on the Metropolis Gas (Surrey Side) Bill have leave to print the minutes of the evidence taken before the committee, day by day, from the committee clerk's

copy, if they think fit;" and—"That the minutes of evidence taken before the committee on the South Metropolitan Gaslight and Coke Bill of the present session be referred to the committee on the Metropolis Gas (Surrey Side) Bill."

POLLUTION OF RIVERS BILL.

Upon the order for resuming the debate upon the second reading of this bill,

Mr. SCLATER-BOOTH proposed that the bill should be read a second time *pro formâ*, and added that he would then place upon the paper certain amendments which he believed would meet the objections to it which had been raised on behalf of the manufacturing interest.

Sir C. DILKE contended that the House ought to be put in possession of the amendments before the bill was read a second time, and moved the adjournment of the debate.

The Marquis of HARTINGTON, whilst sympathizing with the President of the Local Government Board in his desire to pass the bill, could not agree that what he proposed would be a proper way of dealing with so important a subject. The bill not only affected a few manufacturers, but the public interest generally, and it proposed to create a new local authority, as if there were not already more than enough of such authorities.

The CHANCELLOR of the EXCHEQUER thought that the view of the noble lord was unreasonable. The matter had been before Parliament for years, and very considerable time had been spent upon it. Objections to the bill had come from a particular class of persons in the country, the Government had endeavoured to meet those objections; and all that was now asked was that they should simply place upon the table the bill in the form in which they intended to proceed with it.

Mr. RIPLEY, on behalf of the manufacturers, expressed their desire that the rivers of the country should be rendered as pure as possible, and believed the concessions suggested by the President of the Local Government Board would secure that object while not doing injury to the manufacturing interest. He should, therefore, vote against the adjournment of the debate.

After some further conversation, the motion for the adjournment of the debate was agreed to.

FRIDAY, JULY 21.

The Lords amendments to the Cleveland Water Bill were agreed to, with amendments.

The Lords amendments to the Stafford Borough Extension Bill were agreed to.

HOUSE OF COMMONS COMMITTEE.

WEDNESDAY, JULY 19.

(*Before the Right Hon.* W. E. FORSTER, *Chairman; Mr.* GARNIER, *Mr.* GOULDING, *Mr.* STEVENSON, *and Mr.* TREMAYNE.)

METROPOLIS GAS (SURREY SIDE) BILL.

This was the day appointed for the first meeting of the committee, "to choose a chairman and to proceed with the bill."

At 1 o'clock counsel and parties were in attendance. Mr. LITTLER, Q.C., appeared for the Board of Trade, as the promoters of the bill; Mr. CRIPPS, Q.C., for the Metropolitan Board of Works; Mr. VENABLES, Q.C., and Mr. RICHARDS, Q.C., for the several gas companies affected by the bill; Mr. MICHAEL, for the Vestry of Lambeth; and Sir MORDAUNT WELLS, Q.C., for the Vestry of Camberwell.

The committee having assembled, the room was at once cleared, and on the parties being re-admitted,

The CHAIRMAN, addressing counsel, said: I find that the summons to-day is not exactly what I supposed it was. It is stated that the committee were to meet "to choose a chairman and to proceed with the bill." My notion was simply to choose a chairman; but I do not imagine it is anybody's fault that it has been put down, "to proceed with the bill," although it was my impression that we should only meet to-day to choose a chairman. I want just to put before you what, however, rests rather with the committee, though we think we ought to mention it. There is a bill which has been adopted by most of the companies on the north side of London (counsel will correct me if I make a mistake), which has had the assent of the Board of Trade, has got through the House of Commons, and now stands for third reading in the House of Lords. The third reading, I am told, comes on on Friday.

Mr. MICHAEL: It stands for committee of the whole House on Friday.

Mr. VENABLES: What bill is that?

Mr. MICHAEL: The bills of the South Metropolitan and The Gaslight and Coke Companies.

The CHAIRMAN: I thought it was the third reading. However, it is much the same thing. It stands for what is almost the last stage on Friday. Notice has been given of very considerable alterations in that bill. I dare say counsel are all aware of it, and I do not know that I need describe them—one is a notice regarding the value, or declaring what value shall be put upon the companies in the north of London, if they are bought up by the municipal body. Of course, it would be perfectly unbecoming in us to give the slightest opinion on that question; it is not before us, and even if it was, we, as a committee of the House of Commons, must come to a decision quite independent of the House of Lords. But I do think that everybody would meet in a better position if we knew what came of those amendments, before we entered into a discussion of this bill, and, therefore, unless the counsel present can give any good reason why we should not wait till the decision on that point is come to, I would propose that we do not actually proceed with this bill till next Monday. Perhaps Mr. Littler, as counsel for the bill, will give his opinion first on the matter.

Mr. LITTLER: Well, sir, the main objection that I should urge against the course, on the part of the promoters—appreciating all you have said—is that this, being a hybrid bill, will not only have to go through the stage of being passed by you, but also by a committee of the whole House, and have to be introduced by a suspension of Standing Orders in the other House. You know how we are getting on to the inevitable close of the session, and that a few days is of some importance, so that if the committee could see their way to proceed to-morrow, it would be well.

Sir MORDAUNT WELLS: I say, sir, on behalf of the opponents of the bill, that we feel very much the force of what you have stated. We are not able to investigate these matters so long as those questions are pending, and, therefore, we think, on several grounds, it is most advisable that the consideration of the bill should stand over until we know the result of the amendments. I appeared as counsel against the South Metropolitan Bill in the House of Commons, and am, therefore, perfectly well aware how that bill is affected by the notice you mention, and the fact of it having been referred to a committee of the whole House. Therefore, I think, on many grounds, it is most expedient that your suggestion should be carried out. The great difficulty, if this investigation took place——

Mr. LITTLER: I do not know who my learned friend represents, but it is a serious question whether he or Mr. Michael should be allowed to be heard.

Mr. MICHAEL: I am here at the present time, and not objected to, for the Vestry of Lambeth, and I appeared against the South Metropolitan Company's Bill.

The CHAIRMAN: I ought to say this, that hearing any counsel in this matter is merely to give us their opinion. It is not exactly in an official way I have asked for it, and it must not prejudice any dispute hereafter as to whether they have any *locus standi* or not.

Mr. MICHAEL: Sir, I address you under those circumstances. I represented the Lambeth Vestry on a late occasion, and I urged that certain changes should be made in the bill of the South Metropolitan Gas Company. The committee took the same view of the question, and made the changes which I submitted to them, so that the bill as it now stands is an agreed bill in the House of Lords. But the bill before you is at variance with that bill, and I think, therefore, we have a certain claim to ask that an adjournment should take place, in order to see how far the proposition goes; because this is a bill to set aside the provisions of another bill now in the House of Lords. I think, as representing Lambeth, that this is an additional reason why you should wait to see the issue of the motion in the other House before you proceed to consider the provisions of this bill.

Mr. VENABLES: I appear for the companies which are affected by this bill, upon petitions which are against any alterations. We are most anxious that this bill should be heard before this committee. It is a bill which cannot be affected by any proceedings upon another bill which is before the House of Lords. My friend says this is a bill which is inconsistent with the other bill, but the Board of Trade, who are promoting this bill, must be perfectly aware how far, if at all, one bill is inconsistent with the other. They, with the full knowledge of the facts, are nevertheless promoting this bill. We are anxious that this bill should be heard upon its merits. The House of Commons has no power to overrule any decision that may be come to in the House of Lords, and the House of Commons—at least your committee—cannot interfere with them. On the other hand, I do not understand how the decision of the House of Lords, on the two bills referred to, can in any way control the decision of the House of Commons upon this bill. This bill, with which, I believe, every one is ready to proceed, might very well proceed without our assuming what will be the result of the discussion in the House of Lords, whether favourable or not to one party or another. In opening the case for the bill now before the committee, my learned friend (Mr. Littler) would no doubt explain to you exactly what is the nature of the other bills referred to, and would show you how far they are inconsistent the one with the other. But the inquiry into this bill must be quite independent of the others. We are all prepared to go on with this investigation, and I submit that it would be better and more convenient to proceed. I take it that the Board of Trade are promoting this bill with the full knowledge that the other bills are in a certain stage in the House of Lords, and that the House of Lords may adopt any course they think fit. I assume also that those who represent the Board of Trade—Mr. Wyatt, who is their agent, and my learned friend, who appears as their counsel—have authority to state to you what the Board of Trade wish to do.

Mr. LITTLER: I have only one word to say in reply. My friend, Mr. Michael, says there is something inconsistent between this bill and the bills now before the House of Lords. Allow me to say that if there is, it does not arise upon the question as to the price to be paid by the municipality for the purchase of the works, and the decision on that point, whatever it may be, will not affect the position of this bill as to the sole point upon which he, at all events, is entitled to say anything. Whether it does on other points, the committee can judge as well as I can, but I venture to think this will not affect their decision.

Sir MORDAUNT WELLS: Will you allow me, as representing Camberwell——

Mr. LITTLER: I was going to say that both the bills are in the same position, so far as the motion to be made before the committee of the whole House of Lords is concerned, and that is the only point upon which my friend, Mr. Michael, is entitled to be heard. It is obvious, therefore, that it is not a matter affecting the detail of the bill, but rather the question whether the companies are to be compelled to sell their undertakings at a future time, and that might be decided upon this bill when it comes to the House of Lords.

Mr. MICHAEL: One word. The whole question is to be discussed in the House of Lords, not merely the point to which my friend refers—not merely whether or not the companies shall sell at a certain price to the municipal authorities, but the whole question of price, amalgamation, &c.

The CHAIRMAN: I do not think that has anything to do with the question. Unless any other counsel has a remark to make, we must ask you again to withdraw.

The room was then cleared for a few minutes. On the parties being re-admitted,

The CHAIRMAN said: Well, gentlemen, I hope that you will not be much surprised or disappointed when I say that, after consideration, we have come unanimously to the conclusion that it would be probably a saving of time, and probably help us in considering this matter, if we postponed these proceedings until Monday next. (The parties were about to retire.) Stay one moment, and I will just give you a reason. This is not exactly a private bill; it is a public bill referred to a committee, in which we have the assistance of counsel; but we are something in the same position as a committee on a public bill would be—a committee of the House of Commons—and in that case, although there is the greatest possible feeling in the House that their decisions should be come to on the merits of the question, independently of any decisions of the other House, yet discussions are constantly postponed, in order that decisions of the other House may be known, if it is a matter which affects the other House, and may affect the views of those who are in favour and those who are opposed to a bill. We, therefore, cannot help thinking that we shall be in a better position to consider this matter next Monday than we are now. But I must repeat that any gentleman would make a great mistake if he supposed that this implied any opinion of the committee on the matter which is to come before the House of Lords. It does not imply any opinion; and, of course, whatever decision is come to by the House of Lords, we shall be prepared to take that question, as all others, independently of that decision. But I repeat the opinion, that all who are interested in this bill will better know how they stand next Monday than they do at this moment.

Mr. VENABLES: At what hour on Monday?

The CHAIRMAN: Twelve o'clock.

Mr. MICHAEL: I have to ask you to move for an order that the evidence taken on the South Metropolitan Gas Bill may be referred to this committee.

[On Friday night, in consequence of the postponement of the discussion in the House of Lords upon the Chartered and South Metropolitan Bills, the next sitting of this committee was adjourned till Wednesday, July 26.]

SOCIAL SCIENCE CONGRESS.—The following are the special questions for discussion in the Health Department of the Social Science Congress to be held at Liverpool in October next. 1.—What is the best mode of making provision for the supply and storeage of water (*a*) in large towns, such as Liverpool and Manchester; (*b*) in groups of urban communities of lesser size, such as exist in the manufacturing districts of Lancashire and Yorkshire? 2.—What further legal enactments, if any, are required, with a view to arrest the spread of infectious fevers, and how far national and municipal registration is desirable as a means thereto, and if so, what should be the nature of such registration? 3.—What amendments are required in the legislation necessary to prevent the evils arising from noxious vapours and smoke.

GORLESTON AND SOUTHTOWN GAS COMPANY.—It will be remembered that in the present session this company obtained an Act of Incorporation. Their works are now in course of extension, the latest addition being a new gasholder of 63,000 cubic feet capacity, which, with new exhauster, engine, scrubber, and other appliances, have been erected by Messrs. S. Cutler and Sons, of Millwall. On Monday week an entertainment was given to the men employed by the company, Mr. H. Weller, the manager, presiding at a very substantial repast provided for them. Various toasts were proposed and heartily responded to.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

Metropolitan Board of Works.

The Ordinary Weekly Meeting was held on Friday last—Sir J. M. Hogg, M.P., in the chair.

The Solicitor (Mr. Smith) brought up a report upon the Metropolis Gas (Surrey Side) Bill. It stated that on Wednesday, the 19th inst., the select committee of the House of Commons appointed upon this bill, held their first meeting, and elected the Right Hon. W. E. Forster as their chairman, who, after consultation with the committee, stated that in consequence of the debate expected to take place on Friday evening in the House of Lords upon the bills of The Gaslight and Coke Company and the South Metropolitan Gas Company, they thought it desirable to adjourn any proceedings upon this bill until the following Monday, which was accordingly done. On Wednesday last, about two hours before the committee met, he (Mr. Smith) received a copy of the bill with certain amendments, a print of which he now presented. The amendments consisted in striking out the clauses in the original bill relating to the acquisition of land by the companies; limiting clause 61, as to amalgamations, to the four companies on the south side of the Thames, mentioned in the Metropolis Gas Act, 1860; the addition of a provision as to the apportionment of the expenses of the gas referees among the companies, a provision that the gas examiner shall be paid by the Board, and the introduction into the title of the bill of the name of the South Metropolitan Gas Company, and the inclusion of that company in the definition of the companies dealt with by the bill. Of course, any scheme of amalgamation amongst the companies under this bill would be subject to the approval of the Board of Trade. He (Mr. Smith) did not propose to instruct counsel to oppose the provisions of the bill, as they seemed to carry into effect the objects the Board had already agreed to.

[When asked to produce a copy of the bill, it turned out that the solicitor had no copy with him, and a messenger was sent to procure one from the office.]

Mr. Dresser Rogers complained that he had made several applications to the solicitor for a copy of the bill, and had been refused.

Mr. Roche moved, and Mr. Fowler seconded, a resolution, which was agreed to, that the consideration of the solicitor's report should be deferred until copies of the bill were produced.

After the transaction of some other business, the solicitor laid copies of the bill on the table.

Mr. Rogers said the Board were no doubt aware that the bill, as originally presented, had for its object to make the conditions of three of the companies on the south side of London uniform. The Board at first objected to the amalgamation clauses in the bill; but, by the resolution passed at the last meeting, they had assented to those clauses, and to the inclusion in them of the South Metropolitan Gas Company, which it was not intended to embrace as the bill was introduced. The committee of the House of Commons appointed to consider the bill had adjourned their proceedings, and the bill promoted by the South Metropolitan Company had passed the committees of both Houses of Parliament. But in the face of these circumstances, this bill of the Board of Trade, affecting the south side companies, had been changed in constitution and character, without an opportunity being afforded to the members of the Metropolitan Board, most deeply affected thereby, of having an opportunity to express their opinion upon it, or even to obtain a copy for perusal. He maintained that the resolution of the Board at their last meeting was never intended to place the South Metropolitan Company under the whole of the provisions of this bill; it merely expressed the assent of the Board that, if an amalgamation took place of the South London companies, the South Metropolitan Company should be included. The Board had previously affirmed their opinion that 3s. 6d. was a proper initial price for that company; and how could it be supposed that they were now willing to allow them to charge 3s. 9d.?

Mr. Runtz: We did agree to it.

Mr. Rogers denied it, and said the printed minutes of the Board would show that he was correct.

Mr. Roche: This bill, which was entirely altered in its character, was laid before the Board in its amended form at the last minute, when there was no time for its proper consideration. He would ask the solicitor to state clearly to the Board whether this bill was intended to apply equally to the South Metropolitan with the other companies in South London, and whether, notwithstanding the decisions of the committees of both Houses of Parliament that the proper initial price for the South Metropolitan Company was 3s. 6d., this bill would give them an initial price of 3s. 9d.

Mr. Ward (assistant-solicitor): No doubt it is so.

Mr. Roche said in that case he thought the Board were being very unfairly dealt with. On the last occasion it was moved by Mr. Freeman, seconded by some one, and agreed to—"That the clauses in the bill relating to amalgamation should be extended to the South Metropolitan as well as to the other three companies dealt with by the bill;" but he was sure that the Board never intended for one moment to put themselves in the invidious position of asserting, in opposition to that which the House of Lords and the House of Commons had decided, that in the district of that company the price should be 3s. 9d. instead of 3s. 6d., nor did they ever intend by that resolution to authorize, or in any way to sanction, the Board of Trade making an alteration in the bill, in direct antagonism to the reports of the special committees on the private bill of the company. He trusted they would not allow themselves to be drawn into assenting to such a proceeding on the part of that department of the Government, and therefore he would move that the solicitor's report be referred to the Parliamentary Committee for consideration, and to bring up a report thereon next Friday.

Mr. Ward: The committee of the House of Commons upon this bill meet next Monday.

Mr. Fowler: We had better consider the matter at once.

Mr. Freeman said Mr. Roche not having been present at the last meeting of the Board, was under a wrong impression as to the report then presented, and the decision come to by the Board thereon. This bill was a bill promoted by the Board of Trade, and this Board had nothing to do with its origination. All that they had done was this: The Board of Trade informed them that they were very anxious to settle the whole question of the supply of gas in South London, and that they had agreed to certain concessions which the companies were willing to make, and, on their part, to sanction an amalgamation of the companies. They stated, moreover, that they wished to modify certain clauses in opposition to former resolutions passed by this Board, especially with regard to the 3s. 6d. initial price. The purport of the report of the Parliamentary Committee, which was agreed to by this Board last Friday, was a recommendation that the Board should give way in these matters to the Board of Trade. That was the pith and marrow of the whole discussion which then took place, against which Mr. Rogers protested with all his heart and soul, and Mr. Fowler waxed warm and eloquent. Every other point had been previously settled and arranged at the interview which took place at the Board of Trade—viz., that the companies should give up the land clauses, and that this Board should assent to the provision as to the reserve-funds. The only question in dispute was, whether the South Metropolitan Company should have a 3s. 6d. or a 3s. 9d. initial price.

Mr. Rogers: The question was that of amalgamation.

Mr. Freeman: I know that, but it involved the point whether it should be upon the principle of the initial price in the company's district being 3s. 9d.

Mr. Rogers: No, no.

Mr. Freeman: How could it be otherwise? All I can say is, that if the Board resolve to send the question again to the Parliamentary Committee, we shall be happy to go into it. We can do so instantly; but I am bound to assert, as my definite impression, that 3s. 9d. *versus* 3s. 6d. was settled on the last occasion, and it was because of that, Mr. Rogers told us we were not doing our duty, and were inconsistent with ourselves.

Mr. Runtz said, after the long discussion at the last meeting, it was really unnecessary to go over this question again. He would merely remark, as he remarked then, that 3s. 9d. was the initial price settled by Mr. Forster's committee last session for the whole of the Metropolis, including the district of the South Metropolitan Company, and at that time neither Mr. Rogers nor Mr. Fowler objected. But now they wanted to take advantage of the peculiar position of that company, and place them under conditions different from the rest of the companies in London. What the Board agreed to was 3s. 9d., and that was what the Parliamentary Committee decided upon. For himself, he should regret to see the South Metropolitan Company fixed to a 3s. 6d. price, while in every other part of London the price was 3s. 9d. The South Metropolitan were the least likely of all the companies ever to charge 3s. 9d.; it was too much to their interest not to go beyond 3s.; they would rather go below it, because of the operation of the sliding scale, and therefore he hoped the Board would adhere to the resolution they adopted last week.

The Chairman: The motion is to refer the report of the solicitor to the Parliamentary Committee. I understand Mr. Roche moves that and Mr. Freeman seconds it.

Mr. Freeman: I do not second it.

Mr. Runtz: We passed a resolution last week sanctioning the amalgamation of the South Metropolitan Company, and that resolution covered everything.

Mr. Rogers: I beg to say it had nothing to do with it.

Mr. Richardson commented upon the inconsistency of the Board in adopting, at their last meeting, a line of policy in opposition to that which they adopted at the commencement of the session, and in opposition to the expressed opinion of the House of Commons in reference to the South Metropolitan Company.

Mr. Lloyd said he could not understand the remarks which had been made in the course of the discussion on this question, to the effect that, by the decision of the Board last week, the consumers in the South Metropolitan district would have to pay 3s. 9d. for their gas. There was no evidence that any increase in charge would take place at all. No doubt, if the initial price was raised to 3s. 9d., the company would be able to put a little more money into their pockets than otherwise while supplying gas at 3s. He hoped the bill would pass in its present form.

Mr. Fowler said the Board were very unfortunate in all their gas business lately, and after all that had been done, they were now taken by surprise through the introduction by the Board of Trade of a bill, which proposed to legislate for a company which it was never supposed would be included in its provisions. What he understood by the decision arrived at on the last meeting of this Board was, that the four companies were to be permitted to amalgamate *inter se*, the South Metropolitan standing in other respects as to the price charged in their district, in the same position as they were left in by the committee of the House of Commons on their bill. But by the Board of Trade bill, as altered, the South Metropolitan Company were actually included for all purposes. Such a proposition was not in the report of the Parliamentary Committee adopted at the last meeting, nor was it contended for by any gentleman who took part in the discussion thereon. He felt, therefore, that this was something they ought to protest against. He would say nothing upon the general question that day, having already expressed his opinion; but he felt bound to give his assent to what had been already urged, that the consumers in the South Metropolitan district were not fairly dealt with in this matter. He should, therefore, move as an amendment—"That the Board object to the South Metropolitan Company being incorporated in the Metropolis (Surrey Side) Bill."

Mr. Lloyd: That is a rescinding of our former resolution.

Mr. Fowler: I do not think it is.

Mr. Lloyd: I shall take objection to it as such.

Mr. Fowler said it was clear to his mind that nothing was said on the last occasion respecting the South Metropolitan Company being included in this enactment. There was nothing, he admitted, to exclude them, supposing the bill became law, from amalgamating with the other companies, but they must amalgamate upon the terms under which the South Metropolitan Company's own bill was obtained. It was not intended, surely, that if they amalgamated they should be able to raise the price of gas above the rate which the committee on their own bill reported to be the proper price for that district. If such were the case, it would seem that legislation became more difficult and intricate every step that was taken. There ought to be a clear expression of opinion on this point. It was very unfair that the Board should be taken by surprise in the matter, and that those members who represented the districts chiefly affected by these alterations should know nothing about them. In fact, if it had not been that Mr. Rogers called for a copy of the bill, the report of the solicitor would have been passed without any remark being made.

Mr. Rogers seconded the amendment.

Mr. Lloyd: When that amendment is handed in I shall object to it.

The Chairman: If you raise the point of order it will be convenient to have it settled at once.

Mr. Freeman: I venture to ask whether this amendment is not in direct opposition to the letter sent up to the Board of Trade by us?

The Chairman: Do you raise the point of order?

Mr. Freeman: I do.

Mr. Lloyd: I also raise the general question that it is a rescinding of the resolution we have already come to.

The Chairman: I will give my opinion at once. My opinion is that this amendment of Mr. Fowler's is clearly opposed to the motion passed last Friday, and it is quite impossible for me to put it till that motion is rescinded.

Mr. Rogers rose amidst much interruption to address the Board, it being urged that he had already spoken.

The Chairman ruled that the honourable member could speak against the motion for the adoption of the report.

Mr. Rogers said the reason why he thought the report should not be adopted was that the bill of the Board of Trade originally applied to the Phœnix, London, and Surrey Consumers Companies only. The reason for excluding the South Metropolitan was that that company had a bill of their own before Parliament, which had been passed by the House of Commons, and was then being deliberated upon in the House of Lords. The committee on that bill sat for a long time, and came to the decision, after hearing the evidence of experts, that 3s. 6d. was the proper initial price for that district. Mr. Lloyd urged that the matter now in dispute was not of much consequence, and that, if the Surrey Side Bill was passed, this company would not raise their price. But did Mr. Lloyd know what would be the effect if an amalgamation took place under that bill? Did he know that the capital of the company, as compared with that of the Phœnix, was only about two-thirds the amount, and that it would be necessary in such an event to raise the price over the united districts to 3s. 4d. or 3s. 6d. to pay dividends on the united capitals? He was surprised to find the Board setting themselves in opposition to the thrice-repeated decision of the House of Commons as to the initial price of gas in that district, a decision which in former times they had themselves approved. He knew it was of no use to argue the question, but he felt perfectly certain that the House of Commons would never pass the bill, and he was ashamed at a body of men like those present assisting to do an injustice to a large number of consumers.

Mr. ROCHE: I want to ask the solicitor whether the South Metropolitan Gas Company will have a *locus standi* against this bill before the committee?

Mr. WARD: My opinion is that they will.

Mr. ROCHE: I want to know further, whether the inhabitants who are supplied by that company, and who did appear before the committee, when the 3s. 6d. price was fixed, will have an opportunity of appearing on any *locus standi*?

Mr. WARD: The parishes of Lambeth and Camberwell have hitherto on these occasions been represented before the committee.

Mr. ROCHE: Have they petitioned against this bill as amended?

Mr. WARD: They have petitioned generally against the bill, and, of course, they could not petition against amendments which were not in the bill when lodged.

Mr. ROGERS: Are you quite sure that we have a *locus standi* now?

Mr. WARD: That is another question.

Mr. ROCHE: The districts on the south side of the river had a *locus standi* to oppose the bill of the South Metropolitan Company. We took no part in that matter, except to a certain extent, but left the districts most interested to oppose on the question of initial price. They did oppose, and succeeded in their opposition. Now, I want to know clearly whether those same parties have a *locus standi* against this fresh bill when it comes before the committee.

Mr. WARD: That is a question which may have to be argued. They have appeared, and if they get their *locus standi* they will be entitled to be heard against the amendments now introduced, according to the practice of Parliament. But whether or not they will have a *locus standi* is a matter to be argued before the committee.

Mr. ROCHE: This bill, when introduced, did not apply to the South Metropolitan Company. How, then, could those who have an interest in the supply of gas by that company appear against it? What I am very desirous for, so far as we are concerned, is this: A committee of the House of Commons have decided that 3s. 6d. should be the initial price in that district, and I should not like this Board to do anything against it. The solicitor, in his report, states that he does not intend to instruct counsel to oppose the Board of Trade Bill, and I should propose to add "nor to assent to it." (No, no.) You see the position we are in. We go before a parliamentary committee; that committee decide upon a certain point, and it does not appear to be fair that we should now, in some way or other, be drawn into appearing before another committee to say we entirely approve of a totally different settlement. We must maintain our position, and leave these gentlemen who represent the Lambeth and Camberwell districts to fight their battle over again. Do not let us do anything that shall justify them hereafter in saying, "We have you to thank for having lost the advantages which we secured from the first committee."

Mr. WARD: There has been an official letter from this Board addressed to the Board of Trade, showing what this Board understand with regard to the bill.

Mr. ROCHE: May I ask to have that letter read.

Mr. LLOYD: I rise to order. Mr. Roche said he only wanted to ask a question, and now he is going into the general merits of the bill.

The CHAIRMAN: We had better have the letter to the Board of Trade read.

The CLERK read the letter. It stated that the Metropolitan Board, having again taken all the circumstances into consideration, and especially looking to the desirability of a settlement of the gas question during the present session, had agreed to adopt the suggestion of the Board of Trade, that the clauses in the Metropolis Gas (Surrey Side) Bill should be extended, so as to enable the South Metropolitan Company to amalgamate with the other three companies.

Mr. LEGG said he would simply ask the Board to be consistent. They had themselves promoted a gas bill this session, in which the initial price of gas for all the companies was fixed at 3s. 9d. This was considered fair at the time, and was agreed to by every one, even Mr. Fowler and Mr. Rogers.

Mr. FOWLER said it was not agreed to by him, and he moved a distinct resolution on the subject. The honourable member, he was sure, would not wish to misrepresent what he did, but he would remind him and the Board that, when the proposal first came before them, he (Mr. Fowler) moved a resolution that this initial price should not apply to the South Metropolitan Company, and, in consequence of that, a special representation was made to the select committee over which Mr. Forster presided, but Mr. Forster did not see his way to make the exception.

Mr. LEGG said the initial price of 3s. 9d. for all the companies was agreed to by all the rest of the Board except the two gentlemen representing Camberwell and Lambeth. Was it fair or consistent that this Board, acting for the whole Metropolis, having come to that decision, should now resolve that the south should be treated better than the north? It seemed to him that his friend, Mr. Rogers, was fighting a shadow, for whether the initial price were 3s. 9d. or 3s. 6d. it would not in the least affect his district, as there was no probability of the actual price of gas there ever reaching 3s. 6d. The Board having now sent a letter to the Board of Trade, stating their concurrence in the arrangement proposed, they could not consistently decline to adopt the report of the solicitor.

Mr. FREEMAN said the great mistake they had made that day was in entering upon a reconsideration of the policy they settled last week. For himself, he failed to see the inconsistency which had been spoken of during the discussion. The Board might very well advocate a 3s. 6d. initial price in reference to the bill of one company, when that was the only matter to be dealt with; but when the question was the settlement of a price applicable to four companies, who were hereafter to be amalgamated, and supply gas as one undertaking over the whole of the south side of London, it was altogether a different thing, because if the effect of the action they had resolved on was to take a trifle from one district they made greater corresponding concessions to a very much larger district.

The motion for the adoption of the solicitor's report was then put to the vote, when there appeared—

For the motion	13
Against	5
Majority for	8

Mr. DRESSER ROGERS: Do I understand that counsel are to be employed on behalf of this Board to assent to or dissent from the bill?

Mr. LEGG: I rise to order. If the honourable member had listened to the report he would have known that the solicitor does not propose to do anything.

Mr. ROCHE: I understood that no counsel were to appear at all. I think that is the wisest course.

Mr. WARD: It is no doubt important the Board should be represented before the committee of the House of Commons, and they were represented the other day.

The subject then dropped.

The CLERK read a letter from the Board of Trade, stating that they will see that the clause in the Metropolis Gas (Surrey Side) Bill, relating to amalgamation, is altered so as to enable the London, Phœnix, Surrey Consumers and South Metropolitan Gas Companies, or any of them, to amalgamate with each other.

A letter was read from the London Gaslight Company, requesting the sanction of the Board to the erection of a bridge for conveying coals over Nine Elms Lane, and stating that in consideration of the permission being granted, they are willing to contribute to an improvement by widening the road at the place where the bridge would cross it, and for a distance of about 165 feet by setting back their boundary wall some six feet. The letter was referred to the Works Committee.

METROPOLIS WATER SUPPLY.

Major Bolton reports that the water in the river Thames at Hampton, Molesey, and Sunbury (where the intakes of the West Middlesex, Grand Junction, Southwark and Vauxhall, Lambeth, Chelsea, and East London Companies are situated), was very good during the first 23 days of June, and slightly coloured during the rest of the month. The highest flood state of the river was 7 inches above the (6 feet) summer level, and the lowest was 1 inch below summer level. The highest temperature of the water taken at Seething Wells was 69°, and the lowest 56°, while the highest temperature of the air at the same place was 83°, and the lowest 56°. The condition of the water in the river was good on 18, and indifferent on 12 days. These observations were made daily at 9 a.m. The rainfall for the month was 1·42 inches.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 90.)

Mr. G. LIVESEY, of London, read the following paper on

SULPHUR PURIFICATION.

IS THE REDUCTION OF THE SULPHUR COMPOUNDS WORTH THE COST AND TROUBLE IT ENTAILS?

The question at the head of this paper admits of an answer composed of one of the shortest of words; but before stating whether that answer consists of either three or two letters, it may be advisable to examine the question more in detail; to inquire as to the cost in money, as to the charge for labour, the nuisance, and lastly as to the value of the result. Let it be understood, at starting that the question refers to the value of the *reduction*, not the complete removal of the sulphur compounds—the reduction, in fact, of the quantity of sulphur in purified gas, from a trifle over 30 grains to a trifle under 20 grains in the 100 feet of gas.

Under ordinary circumstances, with gas from Newcastle coal, purified by oxide of iron only, the quantity of sulphur in the gas made at the South Metropolitan works from July, 1870, to Dec. 31, 1871, ranged from 25 grains to 42 grains, the average during this period of 1½ years being 32 grains in the 100 feet by the Referees test. During this period there were 415 tests; it was only on two occasions over 40 grains—viz., 40·5 and 42·2; and only on two occasions under 25—viz., 20·5 and 24·9. Possibly the 20·5 was a mistake, so I leave that out of account, and say the range was from 25 to 42. There were 88 tests below 30 grains. The tests were made by a very careful and accurate man. The large quantities of 50, 60, or 70 grains sometimes heard of, have resulted from the lime being kept too long in the purifiers, until a portion of the sulphur that had been absorbed was driven off again; but such results are never found when oxide only is used for purifying.

The system adopted of stating the quantity of sulphur is very misleading; instead of giving it in grains, it would convey a far more correct idea to state it as a per centage. The only difficulty in doing this being the fact that the proportion is so small that it could not be understood. The weight of 100 cubic feet of gas is to most people unknown and even gas managers find it difficult to remember that 100 feet of ordinary gas at, say, specific gravity 42·2°, weigh 22,500 grains, of which the sulphur forms a very small proportion indeed.

20 grains, being	$\frac{1}{1125}$	part or decimally	·00088	or 88	thousandths	per cent.
25	"	$\frac{1}{900}$	"	"	·0011	" 11	hundredths "
30	"	$\frac{1}{750}$	"	"	·0013	" 13	" "
35	"	$\frac{1}{643}$	"	"	·0015	" 15	" "
40	"	$\frac{1}{562}$	"	"	·0018	" 18	" "

Or the quantity may be stated in another form—viz., that of comparative volume; though here we enter on the region of hypothesis, for no one has yet clearly made out in what form these sulphur compounds exist; but supposing for the moment that it is vapour of bisulphide of carbon (which it is not entirely), we have, at 35 grains to the 100 feet, just 5 cubic feet in 10,000, or 1-2000th part by volume.

It does not, however, follow that because the comparative quantity, either by weight or volume, is so small, that it must necessarily be harmless. If it be injurious, the cost of its removal must be counted, and if its presence is found to be a greater evil than the cost and labour and nuisance caused by its removal, it must be taken out if possible.

The first item to be considered is that of cost, and this must be taken under two headings—viz., capital expenditure on extra plant, and revenue or current expenditure, on lime, labour, &c.

First, then, as to the cost of plant, I can state for myself, and from information I have obtained relating to the Chartered and the Imperial Companies, that the extent of purifiers must be more than doubled to reduce this 5 feet of bisulphide vapour, or whatever it is, to about 3 feet in 10,000 feet of gas, to reduce the 30 or 35 grains in 100 feet to a trifle under 20.

To take Beckton first, it is the fact that purifiers which were calculated as being fully equal to the purification of 10 million feet daily, and erected for that purpose, to be used with oxide only, were found, when the reduction of the sulphur compounds became a necessity, not to be of sufficient extent to purify 5 millions.

At the South Metropolitan works, when oxide only was used, the total area of the purifiers, in 1872, was 3200 square feet; this, in 1873, was increased to 7200 feet area, and, instead of the work of purification being easier, it was far more difficult than before, while the quantity of sulphur was only reduced by some 10 grains in the 100 feet. The whole of the condensers and other purifying apparatus had also been increased in proportion, with the futile idea that this would help to reduce the sulphur. A further large addition to the purifiers is now being made.

The case of the Imperial Company comes out even more forcibly. At the half-yearly meeting, in August last, the deputy-governor stated, in his speech from the chair, that the very large sum of £150,000 had been spent on additional purifiers, solely for the purpose of complying with the requirements of the Referees. I confess I could not, at the time, understand how so large an amount could have been expended, but, since I read the statement, I have had the opportunity of seeing some of the additions made by that company to enable them to reduce the sulphur, and this inspection at once removed all scepticism about the £150,000.

At the Shoreditch station of the Imperial Company, the maximum make of gas in 24 hours, previous to the Referees restrictions as to sulphur, was over 5½ million feet, and this great quantity of gas was purified, without difficulty, by ten oxide purifiers, each 24 feet by 17 feet by 5 feet deep, the total area being 4080 square feet, and the total cubical contents 20,400 cubic feet.

Last winter these purifiers, with great difficulty, purified little more than half the quantity of gas previously passed through them, the make of gas at the Shoreditch station being curtailed because the purifiers were not capable of dealing with a larger quantity.

In order again to enable these works to make their maximum quantity for which retorts and all other apparatus are in existence in good order, eight additional purifiers have been erected, each 42 feet by 25 feet by 7 feet deep, the total area of these eight vessels being 8400 square feet, and the total cubical contents 58,800 cubic feet. Probably the old purifiers were rather small, even for oxide, but the additional area amounts to an increase of over 200 per cent., while all the rest of the works remains the same. The cost of these purifiers, including mains, lime-shed, &c., but exclusive of the land, was over £40,000, which, multiplied by 4 (5½ millions, the maximum make at these works, being about one-quarter of the total Imperial maximum make), proves the correctness of the statement of the deputy-governor, that the additional purifiers

alone cost £150,000. This at 7 per cent., the rate of interest paid by the Imperial on their new capital, amounts to a charge of £10,500 a year, to be paid by the public as interest on capital alone to this one company, for the reduction of the sulphur compounds.

The Imperial Company supplied last year about one-fourth of the total London demand for gas. If, therefore, all the other companies have to expend proportionate sums on additional purifiers, the charge for the one item of interest on capital alone will amount to at least £40,000 a year out of the consumers pockets, or not far short of 1d. per 1000 feet.

To this must be added the extra cost of lime purification over oxide, which I find, from Mr. Field's tables, amounts to at least 1d. per 1000; for, with the reduced cost of oxide, and the increased value of the spent material, the purification by this agent costs less than one halfpenny, whereas it cost the Imperial Company last year just 1½d. per 1000, owing to the use of lime; and this item is more likely to increase than to decrease. Probably this cost of lime may be thought excessive. Statements have been made to the effect that lime is as cheap as oxide, and it is not for me to impugn the accuracy of the gentlemen making such statements; it, however, admits of qualification, for in those cases the lime was used in the ordinary way, for the purpose of removing carbonic acid and sulphuretted hydrogen only, without any regard whatever for the other sulphur compounds; one set of purifiers only being used, whereas for the reduction of this other sulphur, the most approved plan is to use three sets of purifiers—the first for carbonic acid; the second set for bisulphide, both charged with lime; and the third set, charged with oxide, for sulphuretted hydrogen only.

Taking the results obtained by Mr. Harris—the engineer who has, perhaps, been the most successful in dealing with this matter—at the Bow Common works (at one time the Great Central), I find that one yard of unslaked lime is used for every 17 tons of coal, or, say, one ton of lime to about 25 tons of coal, and oxide in addition; whereas we have been told that one ton of lime was sufficient for 70 tons of coal, both statements being, doubtless, correct, but to be accounted for by the fact that in the one case the sulphur compounds are dealt with, while in the other they are not touched, and not even thought of.

In our present state of knowledge, nothing but lime is capable of partially dealing with this matter, and this being the case, there are other important considerations, besides that of the money cost, to be taken into account. The use of lime entails great suffering on the poor fellows, who, in order to win bread for their families, have to work in the purifiers. If the foul lime is dry and dusty, the eyes, mouth, and nostrils are very painfully affected, so much so, that it is not an uncommon event for a man, after changing a large box, to be rendered unable to work for some days. Temporary blindness sometimes ensues, and the work has to be given up. The hands are also injured very frequently, especially if there be a wound of any description. Respirators have been tried, and gloves worn, but neither are effectual; in fact, so bad is it, that I have the greatest reluctance to set men to such work. Urgent necessity, and nothing else, compels them to it.

Further, there is the nuisance arising from the foul lime, and the trouble of getting rid of it. In the neighbourhood of those works in London that are under the jurisdiction of the Referees, complaints are universal. The inhabitants complain, the vestries and local boards remonstrate and threaten proceedings. Medical officers and sanitary committees visit the works, and in some cases the companies are indicted for nuisance, as was the Imperial last year for their new works at Bromley. They escaped conviction by showing that the requirements of the Referees compelled them to use lime, and that they took all possible precautions to prevent a nuisance. Since writing this, I have been informed that proceedings for an injunction to restrain the use of lime at the Bromley works have been taken, on the ground of nuisance, notwithstanding that every possible precaution is taken by drawing air through the purifiers before and during changing. Then as to the removal of the spent lime. The Chartered at Beckton, and the Imperial at Bromley, having a vast extent of low ground, which requires filling up, deposit their spent lime on the land for this purpose. This has also been objected to at Bromley, and orders have been given to send the spent lime from the town works of the company to Beckton. A few years ago a suburban company on the north of London was proceeded against for poisoning the water in their neighbourhood, and an injunction was obtained restraining them from depositing any more spent lime, and requiring the removal of some that had already been placed. Supposing the whole of the London gas companies included in the Act of 1860 to be compelled to deal with the sulphur compounds according to the Referees requirements, and supposing, further, that the quantity of lime used at Bow Common be taken as the basis of the calculation—viz., 17 tons of coal to one yard of unslaked lime, which increases to about two yards of foul lime—we find that, after purifying the gas from about 1,500,000 tons of coal, the quantity used last year, there will be some 166,000 yards of foul lime to dispose of, sufficient to cover an area of 34 acres, one yard deep. What is to be done with it?

In some parts of the country the foul lime meets with a ready sale. This is not the case in London; there is only one work in London where the foul lime can be disposed of in this way—viz., Bow Common. The Essex farmers load back with it, paying, I believe, some small sum per yard or per load to the company—and the yield of foul lime from these comparatively small works is sufficient to supply all the demands for it. In all other cases where the companies have no land on which to deposit it, as at Beckton and Bromley—the latter place now shut out, and Beckton even has a limit—they have to pay for its removal, formerly at the rate of 1s. per yard; but as the quantity has increased, so has the cost of getting rid of it gone up, until at the present time one company, not strictly metropolitan, but close to London, pays 5s. per ton for carrying it away by rail.

The companies are in a dilemma—on one side, subject to heavy penalties for an excess of sulphur; on the other, open to action for nuisance caused by the process adopted for the reduction of the sulphur. The authorities see the difficulty, and for this reason probably have not pressed hardly upon the companies. It is really a question for the public; they have to pay, and now that, by the adoption of the principle of the sliding scale in London, the consumers become, in a certain sense, partners with the companies, probably they may consider that they would rather have the gas 2d. per 1000 cheaper with the sulphur, than pay this 2d. for its partial removal, and continue the nuisance of lime to the neighbourhood of the gas-works and elsewhere.

The result of all this cost and trouble for the reduction of the sulphur may be best shown by reference to the last report of the Chief Gas Examiner, for the quarter ended March 31, 1876. At Beckton, Bromley, and Bow the Referees consider lime can be used to any extent. The maximum is fixed for the winter at 20 grains, while all the other stations are allowed 25; the summer limit is, in both cases, 5 grains less:—

		Sulphur.		
		Max.	Min.	Aver.
Chartered Company—				
Pimlico station	cannel gas	30·90	12·80	21·45
Beckton ,,	common gas	19·00	9·20	12·73
Bow ,,	,,	18·30	7·50	13·73
Kensal Green station	,,	17·70(?)	10·00	17·23
Imperial Company—				
Bromley station	,,	29·60	8·60	11·60
St. Pancras ,,	,,	36·10	12·60	20·46
Fulham ,,	,,	23·80	17·00	19·86
Shoreditch ,,	,,	17·90	11·80	15·34
South Metropolitan Company,	common gas	30·70	12·20	21·62

Having seen the extent of the labour the mountain has been put to to bring forth a mouse, let us inquire what is the value of this little mouse. Are the results worth the cost? The first point to be determined is to ascertain the amount of injury, if any, caused by the presence of some 30 grains of sulphur in 100 feet, and to inquire whether this injury, if any, is sensibly diminished by reducing the sulphur to a little below 20 grains.

Is this small quantity of sulphur injurious to health? This has never been even asserted, but it has been asserted that it is injurious to the leather bindings of books, to boots, to calico, to pictures and gilding; but where is the proof. The whole thing has been simply assertion without proof from beginning to end.

As to the books, the most notorious case is that of the library of the Athenæum Club, but in relation to this an eminent chemist told me the other day that he investigated the matter at the time, and found it very difficult to connect the rotting of the leather with the use of gas. He did find acid in the leather, the presence of this acid having led others to the conclusion that it must have come from the gas. But there was another explanation—acid had been used in the preparation of the leather, and this gentleman told me he was unable to say, and certainly unable to prove, that the presence of the acid was due to the use of gas in the library.

Mr. Fraser, of Inverkeithing, informs me that in his library some of the leather binding of his books becomes rotten and some does not in the same gas-lighted room. He finds that those nearest the fire are more rotten than the others, indicating that heat has something to do with it.

Further, leather has been found to rot in the same way, though possibly not so quickly where no gas has been used. Calico rots on board ship, on the voyage to India, but this is accounted for by the dressing put into the goods by the maker. Brasswork tarnishes where no gas is burned, and, as to gilding, I cannot find that a lavish use of gas has any effect whatever upon it. I believe that possibly with brass, the effect of a trace of sulphurous acid in the air of a room to which the brass is exposed continuously may, by a cumulative process, in time produce a slightly injurious effect; but I believe, after very long consideration of the subject, that the oppressiveness felt in a gas-lighted room is due, not at all to the sulphurous acid (a trace of this excellent disinfectant is very probably an advantage), but to the excessive amount of heated moisture present in the atmosphere. When it is remembered that a very large quantity of water is produced by the combustion of gas, and that the greater the heat of the air the greater the proportion of water it can hold suspended, a very sensible effect is produced on the body, for the air, being saturated with moisture, checks the insensible perspiration, and the feeling of oppression necessarily ensues. The heated air, saturated with moisture, is, at least, as likely to be the cause of the alleged injury to leather, &c., as the sulphurous acid, though another theory now appears to be started, to which allusion was made in the JOURNAL OF GAS LIGHTING of last week—viz., if I understand it rightly, that this heated moisture, or the water of combustion, absorbs a very large proportion of oxygen, and thus promotes oxidation.

In the leading article in the JOURNAL OF GAS LIGHTING of Feb. 1 last the following statement was made:—"The products of combustion are, for the most part, water and carbonic acid. There is usually some sulphurous acid produced; but we, who have put the matter to the severest test, have never been able to obtain either an olfactory or a chemical proof of the presence of this gas in the atmosphere of a small room with over 30 gas lights burning in it."

But the most conclusive and unanswerable statement ever put forth on this subject was that made by Dr. Odling in this room, in his lecture to this Association delivered on the 2nd of June, 1868. He said: "I am altogether at issue with the public when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever; and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal gas contains, not 20, but 40 grains of sulphur in 100 feet—a quantity, at any rate, greatly exceeding the reality. Now, making another extravagant assumption, that the whole of these 40 grains of sulphur would be completely burnt—and, in reality, they would be burnt very incompletely—they would furnish, by their combustion 80 grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about 1-15th part of a cubic foot; and since 100 cubic feet of our coal gas give 1-15th of a cubic foot of sulphurous acid, 1500 cubic feet of coal gas would be required to furnish one cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1500 feet of coal gas would produce something besides sulphurous acid. It would produce at least 1000 cubic feet of carbonic acid, and in addition to its dilution by other gases and vapours, we should have our sulphurous acid diluted by 1000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the 1000th part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonic acid furnished by the breath of one individual is equal to that furnished by two 3-feet gas-burners, and that a maximum amount of carbonic acid found in the atmosphere of a crowded theatre was 0·32 per cent. Now, if in addition to our previous unreasonable suppositions, we further suppose that an atmosphere contains 0·2 per cent. of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one half-millionth part of sulphurous acid present in the air of a gas-lighted room."

It therefore appears that this outcry about sulphur is founded on prejudice, and kept alive by ignorance, that all this expense and trouble have been incurred for an idea of no practical consequence whatever. Further, that the remedy has been far worse than the disease, that the evils resulting from the attempt to reduce the sulphur are very real and tangible, while those produced by its presence are of the most doubtful and shadowy description.

One of the strongest proofs that the quantity of sulphur left in gas, purified by oxide only, is of no importance, is the fact that in all cases where the municipal authorities have the supply of gas in their own hands they take care to have no restrictions placed in their Acts of Parliament limiting the quantity of sulphur, and, so far as I can learn, ignore it altogether; consequently, no regular tests are made, and none, of course, published, the result being that the consumers think nothing about it. In Paris, the gas company and the Municipality work harmoniously together on this question. The most eminent chemists of France were consulted as to the best means of purification, and their decision was in favour of oxide of iron exclusively, and that is the system now in use in that city, the sulphur compounds being entirely ignored.

There will doubtless be one argument in favour of lime put forward, and that is that it is useful and necessary for the removal of the carbonic acid, thus improving the gas and enabling cannel to be dispensed with. If lime is used after oxide for this purpose only, many of the evils attending its use are avoided, but it is still objectionable, on account of the extra pressure, and the difficulty of disposing of it. If, however, no other means existed for the removal of the carbonic acid, it would probably be advisable to use lime; but, when we have such a simple and effective process as Hills's purified liquor, lime can be advantageously, entirely dispensed with; the purified liquor removes the carbonic acid and a considerable proportion of the sulphuretted hydrogen, leaving very little to be done by the oxide purifiers, which, with this system, would act more as catch purifiers, and consequently would be of comparatively small extent, and seldom need changing.

I cannot leave this subject without saying how much we are indebted to Mr. Vernon Harcourt for the great amount of time and labour he has given

to the endeavour to find some unobjectionable means of removing the sulphur compounds. He has made experiments by the hundred, extending over a number of years. Let us hope he will attain the success he deserves. The new test for sulphur devised by him is a most useful contrivance, and can be relied upon to give results very near to absolute correctness. I can recommend it to those who have to take frequent tests for sulphur, as an instrument with which they will be pleased, for a test can be made in a few minutes at any time, sufficiently correct for practical working.

I feel sure that, unless the sulphur compounds can be dealt with otherwise than by lime—and, at present, no other process with which I am acquainted has been found available—there are great difficulties ahead, difficulties that will compel the abandonment of lime. There is yet much to be learnt on this question; for the experience of the past two years has convinced me, corroborated by the opinion of eminent gas chemists, that the nature of the sulphur compounds, and the means for their removal, are very imperfectly understood, even now. We need more light on this subject, unless we make short work of it, by taking a common-sense view, as is done in Paris, and by the English corporations supplying gas, who wisely submit to the inevitable, and are content with something short of absolute perfection while they continue in this world.

Mr. BROTHERS, of Blackburn, said he should not presume to address the Association if he had not, during the last two years, taken a more than ordinary interest in the purification of gas from sulphur compounds. In this matter the London engineers had had to bear all the brunt of the battle, although there were a few provincial managers who had suffered in this respect. He quite agreed with Mr. Livesey, and also with another authority, who recently said, "There are more cats than mice," in reference to questions of inspection, and certainly, in respect to the sulphur impurities question, there was much more outcry than needful. At the same time, he believed that these frequent prosecutions—or persecutions—of gas companies would be productive of good, as they would lead to experiments which would end in the discovery of a substitute for lime in purification—some alkaline sulphide, which would, perhaps, more readily remove the sulphur, and yield a mercantile commodity as the result. No doubt, as Mr. Livesey put it, the London consumers had had a tremendous big sulphur nightmare; still, managers must not make too light of the outcry, but endeavour to quiet it. So long as chemists kept up an agitation upon the existence of so much sulphur in gas, and its injurious effects, so long would shopkeepers and others be naturally indignant with the gas companies; but if they could be assured that there was no harm to be apprehended from the presence of such a quantity of sulphurous acid as was produced by the burning of coal gas, as usually supplied, they would be content, especially if the companies were able to supply it at 3d. per 1000 less.

Mr. FRASER, of Inverkeithing, said he did not think it right of him to speak in such an assembly upon scientific matters; but if he could contribute a fact of a practical character, he felt bound to state it. It surprised him, in listening to what had been stated, to find that there was a difficulty in disposing of spent lime in London. He thought if it was known to farmers and market gardeners in the suburbs of the Metropolis, that this refuse material was highly valuable for the land, there would be an abundant demand for it. For himself, he might state that he put on his land and garden all the spent lime he could get, and he found that, where a great deal of manure was employed, it did a large amount of good in killing wireworm and other enemies to the crops. Applied in moderate quantity, the sulphur in the lime destroyed the insects, and rather promoted vegetation. A year or two ago he advised a friend to get some gas lime and put it on his garden, as he was complaining that his carrots were being injured by wireworm. Some months afterwards, on meeting his friend, and inquiring the results of the experiment, his friend said, "I have no crops at all now. You spoke so highly of spent lime, that I resolved to give the land a good dose of it, and the result was to destroy everything." He told his friend he should have applied it in a moderate degree, and the results would have been astonishing. Just in the same way he advised some of his farmer friends that it would do good to their land to apply ammonia waste. One of them did so, and all his turnips were burned up. Ammonia waste, as well as lime, might be misapplied. He would advise the London gas companies to get up a little explanation of the value of spent lime, and print it for circulation among the suburban farmers and market gardeners.

Mr. C. WOODALL of London, thought the Association were much indebted to Mr. Livesey for bringing forward such a paper as the one just read, and he thought the public might feel pretty safe in leaving the matter in the hands of the gas companies when they knew that the man who had for many years been pertinaciously "pegging away" to get the sulphur agitation exploded had done so much in the direction of securing the reduction of that impurity. But he also thought there was a little error on the part of the writer in treating the matter as too insignificant. It was hardly for gas managers to deprecate any demand in the direction of still purer and purer gas. Mr. Livesey had often said publicly, and all present would sympathize in the remark, that if they could improve the quality of the gas supplied, it would not only be their duty, but their pleasure. It was, therefore, a case of comparing and weighing the disadvantages which he had battled against so valiantly (and not one whit too strongly) from a gas maker's point of view, against the disadvantage of retaining it from a consumer's stand-point. It was remarkable that after all the talk and legislation on the question, there had not been the slightest amount of demonstration of the injury said to be done by the presence of this small quantity of sulphur in the gas. He thought that the gas managers of London generally were to be congratulated (though fortunately some of them had had no experience whatever of the difficulties of the Chartered, Imperial, and South Metropolitan Companies) that this matter was in the hands of men like the Referees. The old plan of fixing a maximum, and fining a company if they went above it, was palpably absurd, unless some means were found for keeping within the maximum. At the present time the Referees, who were men of scientific attainment, and men of business habits, were required to fix a maximum dependent upon the varied circumstances of the different works, and, as he said before, the gas managers were to be congratulated that this arrangement had been carried out. The nuisance to a neighbourhood where lime was used was so considerable that he was perfectly certain in the two stations of which he had charge, if there were no other means at command, it would be absolutely necessary to close the works should a large reduction of the sulphur compounds be insisted upon. He thought, at the same time, the process which had been carried out by Mr. Hills, and so ably followed up by Mr. Livesey, and which, moreover, he had himself had some considerable experience in during the last twelve months, gave them reasonable hope that they would be able, in closed vessels, and by the use of that strong ammoniacal liquor which Mr. Anderson had often spoken of as one of the best purifying agents, to reduce these compounds materially. He had found, upon a small scale, that it was possible to get down the sulphur from 30 to 20 grains, but whether it would be possible to get a sufficient amount of liquor, and control it so regularly as to be able to fix a maximum for this impurity, which should not be exceeded, he did not know. He had been in hope of being in a position to place some figures before the members, showing what had been done with strong sulphide of ammonium. He remarked, in conclusion, that it appeared to him the public had reason to be grateful for the existence of this Association, at the meetings of which gas managers had to explain to one another the reasons for any failures in their operations, and that managers themselves might find in it the best means of sharpening up their inventive faculties to enable them to meet any difficulties which might arise in carrying out their duties.

Mr. LIVESEY, in reply, said the first speaker referred to the possibility of finding substitutes for lime. They were being sought for most earnestly at the present time, and Mr. Vernon Harcourt had shown him a book containing records of hundreds of experiments having that object in view. Mr. Hills's process was a process in the same direction. His first idea was that if he could get a caustic ammonia, he could purify gas from sulphuretted hydrogen. Others had tried to do the same thing, and though they had succeeded in accomplishing the object, it had been attended with certain drawbacks, which prevented their practical application. Mr. Hills, by his process, obtained a rough caustic ammonia, which was very efficient, and he (Mr. Livesey) in the summer time, had completely purified his gas by means of it, from sulphuretted hydrogen and carbonic acid. But to do so he had to use so much more than was necessary, to get rid of, say, the last 10 per cent., that he found it better to employ oxide for the purpose. Mr. Hills had gone further in this direction—he suggested that if the carbonic acid was removed, the same effect would be produced with the sulphide of ammonium upon the sulphur compounds, as was produced with the sulphide of lime. As yet this had not succeeded, though he had been at work upon it for the last year. Within the last month or two, he got a very strong sulphide of ammonium, by passing sulphuretted hydrogen into the purified liquor until it contained eight times as much as ordinary liquor contained. But he overdid it, for on using it in a scrubber, the gas carried off the sulphuretted hydrogen with a rush, and it was conveyed rapidly through the whole of the purifiers. Fortunately, the process was being carefully watched, and the foul test obtained at the outlet of the last box caused the stoppage of the experiment. It was found that, instead of eight times the quantity of sulphuretted hydrogen remaining in the liquor, the gas carried off one-half. Then he got a liquor with four times the quantity, and worked that over and over again in the scrubber, but it did not reduce the sulphur compounds a grain. All these experiments, in which he (Mr. Livesey) had been engaged for four or five years, convinced him that it was not even now known, and chemists, with whom he had spoken on the subject, admitted this—the more eminent the more diffident were they in expressing a positive opinion as to how the sulphur could be dealt with. While desirous that the purification of gas should be made as complete as possible, he was of opinion that they might carry refinement of this sort too far. They did not find absolute purity in nature. Some years ago the water companies were persecuted on the ground that their supplies were improper, and an eminent chemist, who analyzed the water, pronounced that of the Kent Water Company very impure, and there was much talk about earthy matters in it, while this very water is now admitted to be the purest in London. Absolutely pure water was not to be obtained, and perhaps if it could be, consumers would not be so well off as they now were with the water containing some lime. Again, some years ago an absolutely accurate measure of gas was desired, and it was thought that nothing better could be done than to employ the Astronomer-Royal to regulate the testing of gas-meters. But here, again, absolute perfection was not to be obtained, and a range of 2 per cent. against the consumer, and 3 per cent. against the companies, was obliged to be allowed. He quite agreed with Mr. Woodall, that in the matter of the purification of gas, it would not be well to represent the question of the sulphur compounds as too insignificant; but his opinion was that its importance had been greatly exaggerated, while the means for their removal were still uncertain. He had just read a letter in the JOURNAL OF GAS LIGHTING from an old friend, Mr. Lewis Thompson, who had done good service to gas companies in his time. The writer referred to a mode of purifying gas from sulphur which he had previously recommended, but which he subsequently found would not succeed on a large scale. He evidently did not think the quantity of sulphur in coal gas, as supplied to the public, was a very serious matter, for, speaking of his process, he remarked that it would "very well meet the requirements of such gas consumers as still believe that the minute quantity of sulphur in common coal gas has an injurious effect upon their welfare in any way. He (Mr. Livesey) remembered a remark once made to him by Professor Tyndall:—"There is nothing perfect in nature; nothing absolutely, scientifically perfect; perfect, no doubt, for the purpose for which it was made, but not absolutely perfect." This question of sulphur purification he could honestly affirm had almost entirely occupied his attention, and that of his assistants, for the last four years, and had diverted their energies from their proper work of gas-making.

Mr. W. J. WARNER, of South Shields, read the following paper on

VARIOUS METHODS OF JOINTING MAINS, WITH A VIEW TO THE REDUCTION OF LEAKAGE.

LAYING AND CONNECTING SERVICES.

These titles in the annual list, "suggestive of subjects to be treated upon,' appear to be so closely connected that they should be covered by one paper. As the titles are rather wide, "Jointing Mains," "Laying and Connecting Services," I will deal with them in the same spirit, gleaning in other fields than those in which we are accustomed to labour. Water-works may thus yield us the fruits of their wider and greater experience—an experience exceedingly interesting from its varied practice and great antiquity.

Anterior to the magnificent aqueducts of the Romans, we find in the remains of the structures of Solomon, around which such a halo of poetic beauty shines, a perfect water conduit. The water runs, it is said, into Solomon's pools "through round earthen pipes, about 10 inches in diameter, which are cased in two stones, hewn out to fit them, and they are covered over with rough stones, well cemented together, the whole being sunk in the ground." Ages afterwards stone water ways were laid down in Manchester, by the celebrated Rennie, but lacking the knowledge or precautions of the ancients—lining them with "earthen pipes," and covering them with "rough stones well cemented together"—the employment of them was attended with most disastrous results to the company, and resulted in the works being transferred, in 1817, to another company.

Palladius, in his treatise, "De Re Rustica," teaches how to find springs, and to conduct the water to farm or villa by a channel constructed of masonry, or by means of pipes of lead, of wood, or even of earthenware; but he testifies his aversion to the use of lead, as apt to become poisonous. Still it may be inferred, by the allusions from the poets, that such pipes had come into very common use. They were not cast tubular, but consisted of thin plates, bent up into the form of a cylinder, and soldered along the edge. The smallest of the pipes employed in distributing the water from the reservoir, or *castellum*, was called a *denaria*, being 10 feet in length (about the length of a modern pipe), the sixteenth part of this in breadth, and weighing 120 Roman pounds, which gives a thickness exactly of a quarter of an English inch. Stow gives the earliest intimation of any attempt being made to supply London with water by means of leaden pipes, "The watercourse being from Paddington to the Crosse, in Cheape, which was begun to be builded in the yeare 1235, but was not completed till 1285." It may be interesting to know "this grant was confirmed by Henry VI., and likewise a writ of Privy Seal issued, allowing the Lord Mayor and citizens power to purchase 200 fodder (loads or tuns) of lead for the intended pipes or conduits; and also to impress plumbers, labourers, &c., for carrying on the said work, provided always that their wages be punctually paid them." To this may be added another interesting fact, quoted by the author of the work from which this is taken—"Hydraulia." It is that "the pipes in those times were not, in some instances, imbedded in the earth, as is the present custom, but inclosed within a capacious arch of brickwork, into which workmen could upon occasion descend to repair any decay or accident."

"In 1610 a Mr. Thomas Hayes, an English gentleman, constructed a conduit, without the gate at Alderagate, to which the water was conveyed from the Thames in pipes of wood and stone."

Stow's "Survey of London," republished 1633, contains the following:—"There is not a street in London but one or other of these waters runs through it in pipes conveyed underground; and from these pipes there is scarce a house, whose rent is £15 or £20 a year, but hath the convenience of water brought into it by small leaden pipes, laid into the great ones." Matthew's "Hydraulia," 1835, gives a considerable amount of interesting information upon the early history of water supply. "At the commencement of their respective operations for supplying the Metropolis," this writer says, "both the London Bridge and New River Works conveyed the water through the different streets by means of wooden pipes, to which leaden pipes of small diameter were attached for conveying it into the house. The wooden pipes, being generally made of elm, which is a soft and porous kind of timber, occasioned many inconveniences, either from fractures or decay; hence they proved a source of constant trouble and expense, from a great part of them requiring to be changed every two, three, or four years . . . . moreover, the nature of the materials, as well as their limited magnitude, necessarily confined the bore of wooden pipes to a comparatively small size, varying from three to six or seven, and a few near the reservoirs might be ten or twelve inches, consequently in order to afford a supply of water to places at a considerable distance from the reservoirs, the use of several lines of such pipes was generally required. In 1810 nine trains were laid side by side along one street . . . . The quantity of water lost by fractures, &c., was estimated at about one-fourth of the whole that entered them from the reservoirs. . . . . For nearly two centuries was this insufficient plan pursued. Whatever may have been the proximate cause of generally substituting pipes of iron for those of wood, the advantages of the change were strikingly important. Certainly, in some cases, they had previously been employed for conveying water to a very limited extent; but the operations of gas lighting rendering them indispensable, its extensive introduction probably suggested the general adoption of their use as conduits for water . . . . Although previous to the year 1810 the New River Company had placed in the earth wooden pipes several hundreds of miles in length, yet during that period and 1820 the whole were taken up, and iron substituted through the entire range of their district. The expense of this alteration amounted to nearly £300,000. . . . When first adopted, it was the practice to make a flanche at each end for the purpose of connecting them together by screw-bolts and nuts; however, a little experience demonstrated the inconvenience of this mode of constructing them, for the expansion and contraction by the variations of temperature occasioned their joinings to become loose and leaky, or the breaking of the pipes. The various injurious effects and disadvantages proceeding from this cause, led to an alteration in their form, which proved an effectual preventive of any defects from the action of heat and cold upon the metal. This important improvement consisted in forming one end of each pipe larger than the other with a kind of socket, several inches in length, into which the narrow end of the corresponding pipe could be inserted, and the space remaining between them closely filled up with hemp, wadding, and lead, so as to render the joint perfectly water tight. By adopting this method of connecting the pipes, the changes of temperature have not the effect of breaking them, though occasionally their joinings become imperfect, and require a little repairing to prevent the escape of water. This improvement is ascribed to Mr. Thomas Simpson, formerly engineer to the Chelsea Water Company. . . . The New River Company's premises were at the bottom of Dorset Street, Salisbury Square, where they had a spacious wharf for landing timber, shops for boring pipes, &c. This site was that on which the City Gas-Works were subsequently erected."

I have been fortunate enough to meet with a sketch of the machinery employed in boring these wooden pipes, and deem it of sufficient interest to place it before you. I found it in the "Dictionary of Arts and Sciences," 1807, Dr. Gregory, who says: "wooden pipes are trees bored with large augers of different sizes, beginning with a less and then proceeding with a larger successively. They are fitted into the extremities of each other, and sold by the foot."

To condense the foregoing for our own use, we find then—

First.—That the length of a lead pipe used by the Romans was about that of our own cast-iron ones.

Second.—That subways in England are more than an old idea; it was carried into practice centuries since, and doubtless, from its being abandoned, was found impracticable, even for water-pipes.

Thirdly.—That the practice of water engineers, in the laying of iron pipes, was of little service to the pioneers of gas lighting, but rather the "extensive introduction" of these pipes, according to Matthews, "probably suggested the general adoption of their use as conduits for water," but

Fourthly.—If flanched pipes only were employed by gas engineers in 1810, we are indebted to an older art for a valuable improvement in canalization.

Lastly.—The experience of the water engineers, which led to the invention of the spigot and faucet, should not be lost upon us; that a system (to put this matter in the most general and least objectionable form) of canalization, as in the human body, should be elastic.

With the rigid system, which was the "turned and bored" wooden pipes, the loss of water was "one-fourth;" with the flanched iron pipes "a little experience demonstrated the inconvenience of this mode of constructing them, for the expansion and contraction by the variations of temperature occasioned their joinings to become loose and leaky, or the breaking of the pipes." The length of each pipe, too, was inconsiderable, which was of great advantage to the system. Dr. Gregory says, "they are cast in forges," and "their usual length is about 2½ feet; several of these are commonly fastened together by means of four screws at each end, with leather or old hat between them to stop the water." Barlow and Babbage, "Encyclopædia of Arts and Manufactures," 1848, bear upon this point: "Commonly now," they say, "the iron-pipes are inserted one within the other, like the old wood pipes, for experience taught engineers that a long and continuous pipe, securely screwed together, exceeding about 300 feet in length, would pull itself to pieces, by the contraction of the iron, from the change of temperature between summer and winter."

I have endeavoured to find the exact date of the invention of the spigot and faucet; but have been unsuccessful. In 1758 a patent was granted for "casting tubular and other metallic articles—guns or cannon, fire-engines, cylinders, pipes, and sugar-rolls;" guns or cannon, however, "according to the antiquarian Lower, Dr. Percy states, were manufactured at Buckstead, in Sussex, by Ralph Hoge Hogge, in 1543." To William Bell, in 1808, a patent was granted for "enclosing in pipes or cases of iron or of wood, pipes or tubes of porcelain pottery." These porcelain tubes are designed for the conveyance of water in preference to wood, which, the inventor states, "is liable to decay and become rotten, generating insects and noxious animalculæ; and that pipes of metal, without the lining of a porcelain pipe, corrode and impregnate the water, rendering it unwholesome and poisonous, and unfit for domestic purposes. Each tube is made with a socket at one end, to receive the plain end of another, leakage being prevented by the introduction of cement." This, then, may fix the date of the formation of the socket; and the joint, the yarn and lead, the true joint, perhaps, was the invention of Mr. Simpson, about this time, or between the years 1808 and 1810. Clegg is entirely devoid of information upon our subject; and Mr. Murdoch's paper, read before the Royal Society in 1805, is most tantalizing. The latter says the gas "is conveyed by iron pipes into large reservoirs, or gasometers," and thence "conveyed through other pipes, called mains." Matthews, however, tells us that "the first street mains laid down in Pall Mall (1807) were lead pipes;" also, "The pipes which Mr. Winsor employed to convey the gas from his apparatus consisted chiefly of lead, and only those parts which connected them with the burners were copper." The same author gives a sheet of drawings of various kinds of "pipes, &c., employed in water-works," selections from which I place before you; also from Accum and Peckstone. It will be observed that the principle of the joint is the same in all, but very different in one point from that shown in Clegg, which is the ordinary socket joint now in general use. The point to which I refer is the absence of a bead on the spigots of pipes in early use. This is essential to the principle upon which the joint was constructed—that it should be elastic, capable of contracting and expanding. Without a bead the joint is a rough gland, each pipe being free, as far as the rough surface will permit, to move in another. With the bead, looking at the joint as a gland, it is theoretically imperfect, and we know in practice that the joint "draws"—lead and packing being drawn from the socket, instead of the spigot moving through, the same as, I believe, was originally intended; though doubtless the roughness of the spigot, and the clip of the lead upon it, would materially affect the practice of what is theoretically correct. This idea of flexibility, too, would be strengthened, if not suggested, at this time (1810) by the practice of James Watt, who constructed a 15-inch flexible water-main across the Clyde, the flexibility being obtained from ball and socket joints; a sketch of this is placed before you. From that time up to the present many schemes have been devised and patented with this object in view; drawings of the most interesting of which will be found hanging on the wall.

The important and very serious subject—leakage from mains or pipes—is, then, not a matter with which we only have to grapple, and to which our attention alone has been directed. I have already stated that the loss with the wooden pipes was 25 per cent. From a paper on "Leakages in Pipes," by Mr. Whitney, Cambridge, U.S., read before the American Society of Civil Engineers in 1873, this matter, it appears, is not less serious now than it was a hundred years ago. The writer says: "The result of his experiments was the discovery of no fewer than 200 leaks of from 1000 to 2000 gallons an hour each. The necessary repairs were made, and thereby the average daily consumption was reduced from 85 to 35 gallons a head." At the very commencement of gas lighting, the subject attracted attention. Sir William Congreve, in one of his reports to a committee of the House of Commons, 1823, recommends "laying all main-pipes in clay, in order to prevent the escape of gas." Before this committee, a Mr. Samuel Lay gave evidence upon this subject; "and his great practice, it is said, with the water company, and then as outdoor superintendent to the Chartered Company, had made him familiar with the effects which had occasionally resulted from the leakage of gas from fractures and imperfections in the mains or small pipes." Our own Association has well discussed this subject, and I do not hesitate to say that in no one matter have we rendered more valuable service to each other and to the undertakings with which we are connected, than in the consideration of this important question, and this Association may well be proud of the benefits it has thus indirectly conferred upon the public. Our Transactions are full of information from the large and varied experience of our most eminent men, and any one, to use the words of a past president, Mr. Edward White, "who looks back through the volumes of our Transactions, will see how worthily the objects for which the Association was called into existence have been carried out." Though agreed upon the one important question—the serious loss from leakage—there is, in the matter of jointing pipes, a diversity of opinion.

Mr. Hawksley, who has so ably presided at our meetings on several occasions, has given us the benefit of his large and varied experience. In closing the discussion on Mr. Cathels's paper on "Leakage from Gas-Mains and Service-Pipes," read at Nottingham in 1867, Mr. Hawksley says: "According to his opinion it did not matter much whether they had the best form of turned and bored joints, or whether they had lead joints well made. . . . It was not worth consideration in the first instance, but with reference to the question of how far these joints became deteriorated by the many accidents to which mains were exposed in the street . . . he certainly, as the result of experience, rather preferred well-made lead joints. They were more elastic." He thus gives us the reason for holding his opinion, and these views are in accordance with the theory and practice of engineers at the beginning of the present century; and the theory upon which this practice rested, doubtless came, as I have attempted to show, from their experience of the unsuitability of such a rigid and inelastic system of mains as they employed in using a flanched joint. Yet so thoroughly is this inelastic system carried out in Manchester, that, "where they could not make use of turned and bored joints," the late Mr. Rafferty said "they made their joints with iron borings;" and "the pipes almost formed," he said on another occasion, "one substance as to closeness," and "expand and contract at the same time;" but how these two conditions could be reconciled he did not attempt to show.

These two systems, the rigid and the elastic, I would make the representatives of two classes, under which all descriptions of joints might be fairly placed, and attempt to take the matter beyond the changing province of opinion and variable individual experience, and place it upon the firm basis of mechanical principles.

One of the prettiest ideas, perhaps, but quite impracticable, is that of a Mr. Williams, of Liverpool, patented in 1869. I say one of the prettiest; I may also add an exceedingly useful one to illustrate, as a working diagram, the practical essentials of a conduit or gas-main. The joint consists of "a perfect spherical zone of an external diameter duly proportioned to the internal diameter of a cylindrical socket, the two services being well and truly fitted to each other, so as to be tight, and having perfect contact by external pressure solely in one circular line or ring of points around the zone. The joint is therefore a moveable one, and in change of level or direction by subsidence or disturbance the pipe line is self-adjusting, and distortion is unattended by leakage or fracture." Theoretically, then, we have here a perfect flexible metallic main, and its description may be taken as the description of the principles upon which a conduit or main should be constructed, "self-adjusting, unattended by leakage, and not liable to fracture," or subject, we may also add, to greater deterioration in the joint than in the pipe.

Now let us examine, first, the change of condition to which a main is liable, and then the common joints as usually employed—the flange, spigot and socket, and turned and bored—and see how far mains thus jointed are capable of adapting themselves to disturbing causes. The greatest disturbance arises unquestionably from the soil itself, either from subsidence under, or pressure from above, the pipes, or from contraction or expansion in the pipes themselves. To simplify the question, we will assume that subsidence, as it is doubtless the most obvious, is the only cause of disturbance. We will assume, also, if you please, that a main under examination was laid horizontally. Now, as a straight line is the shortest distance between any two given points, it is self-evident that if a main between those two points sinks with the ground from subsidence of the soil, it will assume the form of an arc of a circle, and hence must become elongated. This effect, too, will be produced, it may be added, from any disturbing cause but contraction. The main, therefore, to remain sound under these conditions, must be self-adjusting, with an axial freedom (capable of moving around the original common axis of the main), and possessing power of elongation. We here see, at once, in examining the common joints, that the flange is, under these conditions, useless; it has no axial freedom and no power of elongation, but that arising from expansion of each individual pipe, and this power we have excluded in considering the question. The turned and bored we must reject too from the same cause, having no power of elongation, unless some of the joints open as conical valves. The application of the same principles to the consideration of the socket and spigot demonstrates the greater suitability of the joint for the purpose intended, especially without a bead, giving, as it does, a greater amount of axial freedom and elongation than

those at present in use, therefore less liable to fracture or become unsound from disturbing causes. No other form of joint alone will give this freedom. I show diagrams of both a stuffing-box joint and a ball and socket joint (patented). The stuffing-box joint gives longitudinal freedom, but no axial liberty; the ball and socket joint gives the latter, however, but has no power of elongation. Thus we see how beautifully simple is the socket and spigot principle, combining in itself two distinct mechanical actions.

I will not attempt to lay before you the various contrivances for jointing pipes; you may judge of such a task from the fact that up to 1866 nearly 120 patents had been granted for improvements in the same. Most of these are quite unfitted for the purpose for which they were designed, while in others there is to be found such an amount of ingenuity and familiarity with the practical requirements of the work, that they may be studied with advantage by those desirous of pursuing the subject. India-rubber enters, however, very largely into most of the schemes as washers and packing. Collars or thimbles, whole or in sections, with packing of lead or india-rubber, have also been in great favour with inventors.

The same object as Mr. Williams had in view has been attempted another way, by Mr. Guyet, 1857, putting a plain spigot through a flat washer of india-rubber placed in a recessed flange, and secured by a plate of metal. This, however, is but little more than another form of Dr. Normandy's joint; it has, however, the advantage that all sockets have over thimble or collar joints—there is but one joint to connect two socket-pipes, instead of two for a collar. Mr. Homersham, 1869, also combined the principle of a zone with a conical socket.

I have now to draw your attention to my own patented joint. It is a turned cylindrical spigot, with a common socket, indented, grooved, or plain. Over the spigot is placed a flanged sleeve or sheath of thin sheet lead; the flange is placed at the bottom of the socket, and around it a packing of white spun-yarn, then the lead, and thus far the joint is made in the usual way; but on the top and in the middle of the socket a hole is drilled, into which is poured some melted tallow mixed with oil, which, running into the joint amongst the yarn will act as a lubricant to what will then become a glandular joint, and also prevent any escape from the joint if the lead becomes disturbed. Instead of pouring in the tallow, a greased yarn may be caulked in. The thin lead sleeve answers three purposes—first, to keep the loose spigot in a true position in the socket while making the joint; secondly, it prevents the yarn getting through the joint, as I have found it do, into the pipes; thirdly, it allows both a longitudinal and an axial self-adjustment; the thin lead with the elastic packing yielding to the extreme end of the spigot, without disturbing the joint, relieves the socket of the pressure that would otherwise be thrown upon it by disturbance of the ground, the bore being kept clear, too, from the internal taper given to the pipes. It will be seen that the elements of this joint are the same as those that have been long in use, and, therefore, there is no new or untried principle; a new arrangement only to obtain, without complication, a more elastic joint. The cost of the joint is but little more than the common joint, and against this may be placed the saving that will be effected in material and labour in taking up and relaying these pipes, by drawing them out, instead of cutting and breaking the spigot as with the common socket pipe. If compared with the turned and bored pipe, against the cost of the lead joint may be placed the saving of boring the socket, and then the pipes are perfectly elastic and gas-tight when jointed, instead of being a range of tubular valves strung together, for such is the common turned and bored pipe. No movement can take place in these, whether by settlement or contraction, without one or more of these valves opening and permiting the gas to escape. What the escape from mains is may be judged of by studying the table on the wall. So much has been said vaguely upon the subject of leakage from mains and services, and such opposite views have been given expression to in our discussions upon the subject, that I will for a moment return to it, to draw your attention to the tabulated report of the examination of upwards of 23,000 yards of mains. Of this quantity 26·29 per cent. was sound; the leakage on the remainder and services was 1294 feet per hour; or 5·580 feet per hour per 100 yards of main, and there were 13 broken pipes, 194 bad joints, 15 leaky plugs and caps, 137 services, and 10 escapes from other causes. Well may Mr. Jabez Church have said that we "could not dismiss from our minds the conviction that with every consideration, and most careful inspection, there was an enormous amount of waste from the mains and services."

For the repairing of broken main, I employ a segmental thimble or collar, the two halves of which are arranged, so that on being placed together over the main, they may be made to slide into each and wedge themselves together around the pipe, a piece of sheet lead first being placed over the fracture, the joint then being made in the usual way. Thus a permanent joint may be made in the time of a temporary one, and the loss of gas and time and material in cutting out a broken pipe to insert the ordinary collar is saved, and the joint made without the employment of clips with nuts and bolts.

The value of these segmental collars, however useful for this purpose, is much greater for the purpose for which they were designed—to strengthen small mains at the points of junction with the services. It is no unusual thing for an inch service to be inserted into a 2-inch main, and this means cutting nearly one-half of the main through to get the 1¼-inch hole necessary for the 1-inch service. No wonder that we find some of our worst leaks at such places. You will see, by referring to the tabulated report, that we found no less than eight broken pipes on 7383 yards of 2-inch, but not one broken on 6107 yards of 3-inch, and so with the next size larger; in putting a 2-inch service into a 3-inch main, it is considerably weakened by the 2¼-inch hole that must be made. This is not the only evil either, the bore of the main is considerably lessened by the insertion of the service-pipe, and thus the flow materially affected. Now a remedy for this will be found in the employment of this segmental clip, in the form of a T-piece—the joint will be strengthened and the bore kept clear by attaching the service to a socket on the clip, drilling the hole after the clip joint is made, and then screwing the service-pipe into the already tapped socket. Or I would, in the case of very long services, prefer an expansion joint, made on the principle shown for mains. Doubtless the same care in this respect is as necessary in laying services as mains; indeed, I might almost say more so, as they must frequently be laid near to the surface across open areas, thus being exposed to every change of temperature.

Unfortunately, little or no heed is paid to the contraction and expansion which must ultimately affect the joints. We came across such a case a short time since, the service being pulled apart in two places. On 352 feet of pipe (102 feet 2-inch and 250 feet ¾-inch) there was a loss of 30 feet per hour, 3 inches pressure, the pipes having been broken in two places. You will here remember the quotation from Babbage and Barlow, "that a long and continuous, pipe, securely screwed together, exceeding about 300 feet in length, would pull itself to pieces by the contracting of the iron." Both, then, for the sake of the main as for the service, this should be free to adapt itself to disturbing causes, its junction with the main, too, should strengthen it, and in no way affect the bore. The other end of the service also should be well cared for. The cock has been almost entirely neglected, both in its construction and use—¾-inch cocks in many cases not having ½-inch gas-ways, and the plugs never methodically taken out or cleaned or greased, though there are frequent reports of leakage from them. On examining the complaint-book, I find about 5 per cent. of the total number of complaints are from this cause.

I have but one other matter to draw your attention to in connexion with services—their protection from deteriorating influences; whether lead or iron, both equally need this—this you will see from samples laid before you—lead pipes, from the action of some soils and from the lime, being built into the walls of houses; the iron pipe from the soil likewise. The protecting covering, whatever it may be, should be as the pipes themselves, elastic. I will not enter into the question of the relative advantages of lead and iron services. The latter, well protected with tar and sawdust, must be as durable as lead, and cannot be injured—as may be seen by specimens on the table—by picks and tools of other workmen.

I know of no covering to equal what I have now used for some years, tar and sawdust. I have placed a piece of service-pipe on the table, that has been in the ground seven years, and it is as good as the day it was laid. By its side is placed a piece entirely eaten through, in use only a short time longer. The plan hitherto adopted has been to imbed the pipes in a trough of this mixture; but now I find it is better to entirely encase the services, so that in case of disturbance of the ground, the mixture is kept in contact with the pipes, and this I do in a very simple way, by an adaptation of the segmental clip; this arrangement shown by diagram may also be applied to other than service-pipes when laid in bad soils.

The market-place of South Shields is laid out for about 400 stalls, these are lit by portable stand-pipes, the connexions of which are ordinary union joints. With such, as may be supposed, the loss of gas is enormous; and besides this, the stand-pipes are frequently removed without turning off the gas. To remedy this, I have devised the following plan:—Into a small metal box, connected with the service, is screwed a fixed cock plug, over which works the barrel, the outside of which is square. Around the cock thus formed, and at the bottom of the box, is an india-rubber washer; on the under part of the top of the box are two inclines around a circular hole with two grooves; corresponding with these are two feathers on a socket attached to the stand-pipe. By passing the feathered and socketed end of the stand-pipe into the box, and turning it round, the end of the socket will be pressed by the ends of the feathers, passing under the inclined pieces on the under side of the box on to the washer, and form a gas-tight joint, the gas at the same time being turned on. Before the pipe can be removed, it is evident the action must be reversed, and so the turning off of the gas is ensured. Not only for such places, but for all purposes where temporary connexions are required, such stand-pipes and connexions will be useful, but especially for taking pressures, which should be done through every district periodically. It will be remembered that in the evidence taken before the select committee on the Metropolis Gas Companies Bill (1875), that this matter occupies a prominent position towards the end of the report, both Mr. Keates and Mr. Pole being examined upon the point as to the practicability of complying with the eighth clause, taking the pressure "at the main near the junction therewith of every customer's service-pipe." With this arrangement, it is obvious that the pressure could be most readily and satisfactorily taken.

I have but one other matter to place before you before leaving my subject. In my paper of 1873, on the "Distribution of Gas," the following occurs:—"Indeed, with the great loss sustained by some companies, it may be almost a question for consideration whether it would not be advisable, as it was in the case of pressure, to have a separate instrument for each district, rather than one common to the whole, to have a meter or meters as well as a governor upon each main." I explained my arrangement for carrying this out in a modified form—a fixed meter in the governor-room, with a system of valves for testing each district through the summer nights. But I would extend this principle still further, subdividing each district, and placing upon it a fixed meter and hydraulic valve. On the normal consumption then being ascertained, the closing of the valve or valves would bye-pass the gas through the meter, and give, by a short observation, a very reliable test of the portion cut off. In districts with shifting soil, this arrangement will be the means of saving a considerable quantity of gas; by periodical testing any considerable leakage would at once be indicated. The arrangement, too, is useful in laying and testing mains, the connexion being so readily made and broken for the testing without the trouble of shifting the meter, &c. Models of this, with the joint and clip, will be found on the table. To all such valves I would attach the service-pipe of the nearest lamp, glazing the top with red glass, and fixing the end of the service in a position to be sealed before the mains were affected by neglect of the valve: all syphons, too, could have this danger-signal readily applied, and thus an effectual guard be employed against neglect or accident.

Such precautions as these, and what I have laid before you, cannot be too strongly insisted upon, as the economy in distribution is dependent upon them. I would not elaborate or complicate distribution; but the exigencies of the work are such, and so vitally affect the interests of our undertakings, that every practical safeguard should be impressed into the service. Durability and adaptability should be our two watchwords—durability of the mains and services, durability of the joints; the adaptability of both to the changes of condition to which they are subjected. Upon the consideration and observance of these watchwords economy is dependent, not upon the nominal cheapness of the first cost of the plant, and on the more or less conscientious observance of them, so a greater or less degree of economy will be effected.

Mr. FRASER, of London, said he had listened with great pleasure to the paper, which appeared to give a very lucid description of the various methods of pipe-jointing that had been in use for some time past, the object of the writer being to draw comparisons between previous systems and those which now prevailed. He (Mr. Fraser) had paid great attention to this subject, knowing the vast importance of having mains well laid. The question of leakage was a serious one for all companies, the success of their undertakings depending not so much upon the quantity of gas made, as on the quantity delivered and represented at the consumers meters. Anything, therefore, that would tend to reduce leakage would be hailed by gas managers with great satisfaction. There was only one thing in the paper, and looking at the drawings on the wall, which it occurred to him to remark upon, and that was, that the indent of the socket ought to be farther on in the joint; for, unless the joint was a perfect one without ramming, when the men came to "set up," they would detach the piece of lead from the joint, and thus destroy the virtue of the arrangement.

Mr. WHITEHEAD, of Dronfield, said he happened to be connected with a company who had suffered considerably from loss of gas by leakage—perhaps as much as any company in existence. So great was it at one time that they could not get more than 8-10ths pressure at a distance of 300 yards from the works. He accordingly directed his attention to remedying this state of things, and, by attention to the state of the mains, he had been able to reduce the leakage, which had been nearer 50 per cent. than 10, to a fourth of that rate. In ascertaining where the leakage existed, he employed a small gas-holder and a pair of cylindrical bellows. When the ground was opened and the main cut, the bellows were employed to pump gas from the main behind him, in which the pressure was so low, until the holder was filled. It was then forced at the required pressure—say, 4 inches—into that portion of the main to be tested, and in that way the leakage was discovered.

Mr. BROTHERS said he was engaged by the Oriental Gas Company, some three years ago, to reduce the leakage which had occurred in their mains in Calcutta from the execution of drainage works by the Municipality. He, therefore, knew something about the importance of the subject dealt with in the paper. With regard to the remarks just made about the use of a gas-holder to test the leakage, he might mention that Mr. Blackburn, the engineer of the Oriental Company, and himself, adopted a very simple expedient for the purpose. They happened to have in stock a tin-case 50-light Sugg's meter, upon the spindle of which they put a common handle, to turn it, and thus converted it into a kind of exhauster. This meter was taken to the side of the main which it was desired to test. The ground was opened, and the main was

plugged with clay at certain distances; the meter was then fixed, and pressure-gauges placed at given spots. A pressure of 8 or 10 inches having been put on, the tap was shut off, and it was soon ascertained whether there was any leakage or not. If there was, the main was divided again into smaller sections until the leakage was discovered. In this way they tested upwards of 50 miles of mains with good results.

Mr. WARNER briefly replied.

(To be continued.)

WIGAN CORPORATION GAS-WORKS.

PROPOSED EXTENSIONS.—LOCAL GOVERNMENT BOARD INQUIRY.

On Wednesday last, July 19, an inquiry was held by Mr. Jos. SMITH, C.E., with reference to an application of the Corporation to the Local Government Board, for permission to borrow the sum of £10,000 for the extension and improvement of the gas-works.

The TOWN-CLERK (Mr. Maskell Peace) called the attention of the inspector to the circumstances under which the inquiry was held. He said that for some time past numerous complaints had been made to the corporation of the insufficient supply of gas, and they had even been threatened with legal proceedings by one of the local boards in the district. An examination had been made of the mains, and they had been found altogether inadequate to secure a better supply. When the mains were first laid the population was much less than now. Under the Wigan Improvement Act of 1874, the corporation were authorized to borrow £140,000, and with the consent of the Local Government Board a further sum of £50,000. They now asked for sanction to borrow £10,000 for the extension and improvement of the gas-works, an estimate of which had been prepared by the manager, Mr. J. G. Hawkins.

Alderman HOPWOOD, chairman of the Gas Committee, said that since the purchase of the gas-works the corporation had found it necessary to make the improvements mentioned in Mr. Hawkins's report. Repeated complaints had been made of the insufficient pressure both in the town and the outlying districts, and he believed the solicitor of the Standish Local Board had been instructed to take proceedings in consequence. They found it necessary this year to relay some of the principal mains of the town, in order to ensure a better supply. It was also necessary to relay the mains to Pemberton and Standish. The length of main from Wigan to Standish was about 4000 yards, to Pemberton 3066 yards, and to Goose Green and Poolstock 3200 yards. It was also necessary to put a new trunk main in Chapel Lane 546 yards long, another trunk main 346 yards, and another in Wallgate 167 yards, making a total of 9512 yards, the cost of which, with contingencies, would amount to £10,000. A good deal of waste was incurred through leakage, caused by the subsidence of the ground.

Mr. HAWKINS said he had been manager of the gas-works from Feb. 2. When he came he found that extensive alterations and additions were necessary. In consequence of the breakage of the pipes, and the attendant leakage, the pressure had to be kept up to 30-10ths. The illuminating power of the gas was 18 candles. The relaying of the mains of the sizes proposed would remove the complaints of the outlying districts, and it was absolutely necessary to relay the mains, and also to provide additional machinery, &c., at the gas-works. His estimate for carrying out the work was £9512, and, allowing for contingencies, the sum of £10,000 would be required. The estimated cost of extensions in hand was as follows:—Extension of mains in the Pemberton district, £2420; Standish district, £2246; Goose Green district, £800; Diconson Lane and Scott Lane district, £500; trunk main from gas-works to Market-place, £1627; additional exhauster and engine and fixing, £480; new bench of 98 through retorts complete, £839; new tar and ammoniacal liquor tank, 60 ft. diameter by 20 feet deep, two additional 18-inch governors complete, £150; total, £9512. He had divided the area of the gas supply into three districts, namely, (1) Aspull and Scholes, (2) Standish and town, and (3) Pemberton, Upholland, and Goose Green. Each district was so arranged that if there was a break-down it could be shut off in sections. If the governor in one district failed in its action, it would be remedied by means of self-acting valves. The area of the gas district was 20,600 acres.

Mr. JAMES PLATT proved the posting of the notice announcing the inquiry.

Mr. WM. HOLT, borough treasurer, stated that the loan of £140,000 authorized by the Improvement Act had been raised to pay for the gas-works. The gas was supplied at the rate of 3s. 10d. per 1000, with an allowance of 10 per cent. for quantities under 150,000 feet, and 20 per cent. if over 150,000, provided the account was paid within a month. Two years before the gas-works came into possession of the corporation, the dividend to the shareholders was paid out of the reserve-fund, and not out of revenue account. During the year ending June 30, 1874, the quantity of gas made at the works was 139,721,600 cubic feet, and the loss through defective pipes within the same period was 56,235,760 feet, or 35 per cent. of the total quantity manufactured.

The COMMISSIONER said the maximum allowance for leakage ought not to exceed 10 per cent. At that rate the old gas company would have very soon exhausted all their reserve-fund.

Mr. HAWKINS, in reply to further questions, said the increase of production of gas at the works for the year ending June 30, 1876, was 13,213,500 cubic feet, or 11·6 per cent., and the total quantity made was over 163 million feet. The corporation accounts from Sept. 1, 1874, to Aug. 31, 1875, showed a loss on trading account amounting to £2104 9s. 4½d., in addition to which interest was paid to the old Wigan Gas Company amounting to £1773 19s. 2d., bank interest and commission, £2131 11s. 7d.; debenture interest, £1054 13s. 11d., and £2850 11s. 0d.; bank interest, £172 16s. 8d., making a total loss of £6065 13s. 2d. for the year.

The TOWN-CLERK remarked that the price of materials was now very much below what it was during the time that the last statement of accounts was published.

The COMMISSIONER asked if any one was in attendance to oppose the application, and no reply having been made, he declared the inquiry closed.

Subsequently, in company with the members of the corporation, the town-clerk, and the gas manager, the Commissioner inspected the gas-works, and the laying down of the new mains now in progress, and said his report would be presented to the Local Government Board in due time.

REDUCTIONS IN THE PRICE OF GAS.—The Maidstone Gas Company announce that the price of their gas has been reduced from 3s. 6d. to 3s. 3d. per 1000; and the Worcester New Gaslight Company have intimated an increase in the discount allowed for payment within one month after quarter-day from 4d. to 6d., thus reducing the price of gas from 3s. 8d. to 3s. 6d. net. At Wokingham the price has been reduced from 5s. 11s. to 5s. 5d.; and at Berwick from 6s. 8d. to 6s. 3d. At Wigston a reduction of 10d. per 1000 will take place on Oct. 1.

WOKINGHAM GAS COMPANY.—The annual meeting of shareholders was held on the 12th inst.—Mr. W. Wheeler in the chair—when the secretary submitted the accounts, which were approved. The directors were enabled to declare a dividend of 5 per cent., free of income-tax, and to reduce the price of gas 6d. per 1000 feet to the consumers. The price will now be 5s. 5d. per 1000. The retiring directors were re-elected, and the thanks of the meeting accorded to the chairman. A report was read from the company's engineer, and it was resolved to call a special meeting of the shareholders to consider the propriety of increasing the capital of the company, in order to enlarge the works and mains.

ANALYSIS OF POTABLE WATERS.

In our last two numbers we have published the lecture by Dr. Frankland, at the meeting of the Chemical Society on the 17th of February last, on "Some Points in the Analysis of Potable Waters." We now report the discussion which took place thereon.

At the close of the lecture, the PRESIDENT said whatever difference of opinion might exist amongst those present as to the comparative value of the method advocated by Dr. Frankland, there could be no doubt as to the unanimity with which they had expressed their thanks to him for his excellent lecture. He thought it would be as well to confine the discussion, as far as possible, to three principal points—(1) The question of pre-existing sewage contamination; (2) the direct determination of carbon and nitrogen by combustion; and (3) the value of the so-called albumenoid ammonia process. Although the advanced hour precluded them entering fully into the subject, he would, at all events, ask Professor Wanklyn if he would be good enough to open the discussion.

Professor WANKLYN said it was pretty nearly eight years ago since he had been at any of the meetings of the society, and almost the last time he was there he had urged objections against the process of Frankland and Armstrong, which had not been answered. There were objections to it as a process of manipulation. If a sufficiency of an organic substance were taken, say, 0·200 gramme, by careful manipulation the carbon could be determined within 1-200th of the amount, and the process for nitrogen was about as accurate. The limit of error being about 0·5 milligramme on the carbon when 0·2 grain substance was taken, whilst Dr. Frankland only took about 0·02 grain, it was necessary to show that the possible error was diminished by at least one-tenth, or to within 0·05 milligramme. He did not believe any improvement in the manipulation would overcome this difficulty. In the experiments which the lecturer had made to test his process by weighing out known quantities of nitrogenous substances, and adding them to pure water, he had omitted to add any nitrate. Now, one of the greatest difficulties which were encountered was to destroy the nitrates without affecting the organic constituents. He would only advert to one other objection which was fundamental, as it was inherent to the process, and could not be avoided by any manipulation, however careful. If sawdust was moistened, and a current of air passed over, it was found that carbonic acid was produced; prolonged exposure to moisture in the presence of atmospheric oxygen changed it. How much more likely that the prolonged exposure of the organic matter in water at a high temperature in the presence of air should change it; a portion of the organic matter of the water was sent into the air, and Professor Frankland made a combustion of the remainder. An objection which the lecturer urged against the albumenoid ammonia process was that the results obtained by it and by his method did not agree; he never expected they would. It was not professed that the process showed the total organic nitrogen. By taking albumen, and treating it by one modification of their process, you could obtain the whole of the nitrogen as ammonia, and by another modification only a definite fraction of it, and yet he had deliberately rejected the former and adopted the latter for the determination of nitrogen in waters. When he obtained ammonia from water by this process, the amount of ammonia expressed rigidly the total amount of albumen and albumenoid substance in the waters.

On the suggestion of Dr. WARREN DE LA RUE the discussion was adjourned until the next meeting, on Thursday, March 2.

The discussion was opened on the second evening by Professor ABEL, the president, who remarked that at the last meeting he had ventured to point out that there were three points especially to which it would be as well to confine the discussion. These were—first, the direct process for determining the carbon and nitrogen of Messrs. Frankland and Armstrong; secondly, the albuminoid ammonia process of Messrs. Wanklyn, Chapman, and Smith; and, thirdly, the evidence of pre-existing sewage contamination, and its value as affording indications of the wholesomeness of a potable water. Dr. Frankland had had a large experience, extending over many years, in the application of his method; and the diagrams which were exhibited afforded incontestable evidence of its value, showing as they did, not only the relative purity of waters from different sources, and the fluctuations caused by floods, but also the more minute details of the variation in water supplied by different companies from one and the same source, caused by differences in storeage, the power of excluding flood-waters, &c. Since the process was first introduced various improvements had been made, which evidently much facilitated and expedited its working, especially in the method of evaporation; but there were one or two points upon which he would like to elicit information. The evaporation to dryness certainly appeared to be a weak point; for although, no doubt, the carbon and nitrogen in the residue obtained could be most accurately determined, did the residue really contain the whole of the organic matter present in the water? Were there any organic matters, however small in quantity, carried off mechanically or oxidized during the evaporation? The sulphurous acid used in the evaporation process, moreover, must become in part oxidized; did the small quantity of sulphuric acid thus formed cause the destruction or removal of any proportion of the organic matter? Again, when nitrates were present, certain precautions were prescribed; but had it been proved that the nitrates were always entirely removed by the evaporation with sulphurous acid, even with the addition of ferric chloride? Dr. Frankland had published certain results, in which organic matter of known composition had been added in known quantities to pure water, and the amount in the residue determined; but he did not know whether any nitrates were present in these cases, or if so what effect their presence and the consequent treatment of the water had upon the results obtained. With regard to the albuminoid ammonia method, which was very extensively used, and with which he himself had had some experience, although it gave concordant results if uniformly conducted, yet if he were asked, he could not say exactly what it indicated by itself in regard to the character of organic impurities in water; but viewing the results which it furnished in connexion with the inorganic constituents and with the nature of the source, the surroundings, and previous history of the water, &c., they were certainly of value in aiding towards a correct conclusion regarding the wholesomeness of a potable water.

Professor WANKLYN said: Besides the impracticable character of the "combustion" process of water analysis (to which character the discoverers of the process ascribe its almost universal rejection by chemists) another defect in the process has prevented chemists from resorting to it. This defect may be broadly said to be that whilst the process professes to measure the carbon and nitrogen existing in organic combination in drinking waters, it fails to make these measurements. This failure follows as a necessary consequence from two of the conditions under which the process is placed. One of these conditions is that, before resorting to "combustion," there is an evaporation of the water to dryness, and that destruction of the organic matter occurs during this evaporation. Some of the organic substances present in drinking water are very perishable, and others, doubtless, are almost indestructible when exposed for several hours to the action of air and moisture at temperatures not exceeding 100° C. The few milligrammes of organic matter contained in a litre of drinking waters are probably in no single instance preserved absolutely intact in the residue left on evaporating a litre of water down to dryness. In some cases, indeed, not one-thousandth part of the organic matter originally present in the water will survive the evaporation. If, then, the actual combustion itself were perfectly devoid of experimental error, it follows, as a matter of necessity, that the combustion process of water analysis must sometimes fail to measure 999-1000ths of the carbon and nitrogen existing in organic combination in drinking water. The second condition under which the "combustion" process of water analysis is placed, and which renders it a failure, is, that owing to the extreme minuteness of the proportion of organic matter in drinking water, the combustion has to be made on too small a scale. Instead of burning the quantity of organic matter,

which chemists are accustomed to employ—viz., from 0·1 to 0·5 gramme—the operator burns only a few milligrammes when he practises the Frankland process. Unless, therefore, the absolute experimental error had been diminished by the modifications of the operation of combustion, it will be acknowledged that the error of experiment is so large as to render illusory the measurement of organic carbon and nitrogen in drinking water. Has Dr. Frankland diminished the absolute error in combustion? The paper read by Dr. Frankland to this society in the year 1868 shows that at that date he had not diminished it. On a former occasion—viz., in the year 1868—having burnt centigrammes of organic substance, whilst chemists usually burn decigrammes, he made an absolute error of about 1-22nd of the quantity of carbon operated upon; and (since the usual experimental error is 1-200th) it will be seen that the absolute error remained about the same. The lecturer has alleged that the accuracy of the process has been increased since 1868, and in the appendix to the last report of the Rivers Commission (*vide* p. 505), three experiments on sulphate of quinine are published in support of that assertion. A correspondence published in the *Chemical News* sheds light on the character of these experiments, and I presume that the majority of chemists will not place implicit confidence in them. To those chemists (if any such there be) who are convinced by the quinine experiments, and who believe that the absolute error, which was 0·30 milligramme of nitrogen in the year 1868, had diminished to 0·01 milligramme in the year 1873, I would suggest that the curve showing the amount of organic matter in Thames water during the last eight years must surely be the curve expressing the improvement in the Frankland process. And highly interesting it is that this should follow the flow of the river Thames. Passing next to the lecturer's criticisms of the ammonia process of water analysis, invented by Chapman, Smith, and myself, I will be very brief. The statements that "the actual present organic matter in water can only be ascertained by the estimation of the carbon and nitrogen," and that "the albuminoid ammonia process affords no evidence of the absolute quantity either of the organic matter or of organic nitrogen present in potable waters," are based on a long exploded fallacy which I believe Liebig once encountered. The fallacy is that the only quantitative operation to which organic compounds can be submitted is the process of elementary analysis into carbonic acid, water, and nitrogen. I will answer it by a parallel. Acetic ether may be made to yield acetic acid quite quantitatively; and in whatever sense the carbon contained in acetic ether can be said to be a measure or index to the acetic ether, in that same sense the acetic acid is a measure or index to the acetic ether. An unknown mixture of acetates could not be absolutely measured by the carbon it contains, neither could the mixture be absolutely measured by the acetic acid which it gives. But in whatever sense the carbon can be said to be an approximate measure of the mixed acetates, in that same sense is the acetic acid a measure. For acetic acid, read albuminoid ammonia; for acetic ether, read albuminous substances; and for mixed articles, read the miscellaneous nitrogenous organic matters in drinking water, and the parallel is complete. To the lecturer's objection that there are nitrogenous organic substances which yield no albuminoid ammonia, I answer that urea is the only one which is likely to occur in drinking water, and urea is fully provided for by the ammonia process. If perchance a trace of nitro-compound ever make its way into drinking water, it would not be detected by the ammonia process. But that is no objection to the ammonia process, which is designed to measure the albuminoid substances and miscellaneous nitrogenous *débris* in water, and which is all the more valuable for not confounding nitro-compounds with them. The lecturer's assertion that my colleagues and I "declared the waters of Bala Lake, and that supplied to Manchester from the Derbyshire Hills, to be no purer than Thames water," is a very curious misrepresentation of what we really do maintain. The passage requires the insertion of the word "filtered," and then would be correct. That filtered water is clean, and that rain water is sometimes foul, has been taught us by the ammonia process, and is, indeed, consonant with reason. On the subject of pre-existing sewage contamination I need say very little. The cleanest water that is found in nature is loaded with nitrates, the dirtiest is sometimes almost devoid of nitrates; and the same river water is at one time charged with nitrates, and at another time devoid of nitrates, and suffers no corresponding fluctuation in the sewage poured into it. Knowing this, I cannot understand how nitrates can indicate previous sewage contamination and, as is well known, I systematically disregard them in the ordinary course of water analysis. I am even disposed to look on their presence as evidence that the water which contains them has undergone purification.

Dr. LETHEBY, in responding to the call of the president, said: I am sorry I was not present at the last meeting of the society, when Dr. Frankland gave his lecture on the subject in question; but I venture to think I may very safely conclude that it was an epitome, or *rechauffé*, of the big Blue-Book which I see upon the table, and which I have frequently encountered, in the solemn custody of the author, in the lobbies and committee-rooms of the House of Commons; and as the contents of that book are pretty well known to me in my professional capacity, I do not hesitate to discuss them. I may premise that the subject which it professed to deal with is not merely of scientific interest, in a chemical point of view, but has unquestionably a much larger interest in its relation to the public health; for it is a matter of serious importance whether the processes proposed by Dr. Frankland for the chemical analysis of water, as well as the remarkable phraseology in which the results are expressed, are entitled to confidence. As regards the process, which has from the beginning commanded a large share of my attention, I am compelled to say that it has not satisfied me, either in a theoretical or practical sense. Theoretically, it is open to serious objection, from the moment that the sulphurous acid is added to the water to be analyzed, until the final results of combustion are obtained. There is not, indeed, a single step or stage of the process that is not liable to the gravest objections on the score of uncertainty; and I beg of you to remember that, in analyzing water for organic matter, we are dealing with very small quantities of material, and, therefore, even small errors in the results become of great importance. In the first step of the process (the evaporation of the water), there are two serious dangers to be encountered—namely, the loss of organic matter, on the one hand, as by the mechanical vaporization of it, or the destruction of it by atmospheric oxygen or by the action of the sulphuric acid which will undoubtedly be formed by the oxidation of the sulphurous acid; or, on the other hand, the gain of organic matter from the almost unavoidable access of atmospheric dust. It must be remembered, too, that for the purpose of getting rid of carbonic acid of carbonates, and nitric acid of nitrates, which are almost invariably present in all natural waters, a sufficiency of sulphurous acid must be added to displace these acids; and in the case of the nitric acid, to destroy it. Now, in this operation it is almost impossible to adjust the reagent in such manner as to ensure its presence in the right proportion, for if it be in excess, it will, by its oxidation, form sulphuric acid, which will destroy the organic matter; and, if it be in too small a quantity, it will fail to decompose the whole of the nitric acid. In one case, organic nitrogen will be lost, and in the other the nitrogen of the nitric acid will falsely enhance the results. And here I may state that, for the purpose of attacking the nitric acid effectively, it is necessary that the acid should be displaced from its combinations, and this can only happen by the formation of sulphuric acid, which at a boiling temperature is inimical to organic matter. We are thus upon the horns of a dilemma—we either lose organic matter from the action of sulphuric acid upon it, or we gain organic nitrogen (or what would be called organic nitrogen) from the failure of the decomposition of nitric acid. Moreover, there is in most natural waters a notable proportion of actual or saline ammonia, which cannot fail to affect the results, for there are no means of ascertaining how much or little of it has been lost during the evaporation, even when the water is acid from sulphurous or sulphuric acids. And then, in the subsequent stages of the process, the removal of the solid residuum from the evaporating dish, and its mixture with the combustion materials, and the introduction of it into the combustion tube, there are great difficulties and dangers of contamination with dust and dirt and organic impurities. Even while the combustion process is going on, there is a difficulty, on the one hand, of ensuring the removal of all the carbonic acid and nitrogen, and, on the other, of preventing such a slight leakage of some part of the apparatus as will exaggerate the results. These theoretical difficulties have perplexed me from the very moment that Dr. Frankland explained to me the details of the process, and I am sorry to say that the test of actual experiment has not removed them. Being desirous to adopt the process if it were practicable and reliable, I requested my colleague, Dr. Tidy, to see Dr. Frankland, and learn from him all the particulars of the process, and then to give it a full and fair trial. This he did, as far back as the year 1867, and, after making about seventy experiments with substances of known composition, he found the results to be so conflicting and inaccurate, that we were compelled unwillingly to abandon the process. My friend, Dr. Tidy, is present, and will, no doubt, give a full account of his work in this matter; but the conclusions we arrived at were that, if the process had been designed for medico-legal purposes, its results would have been too untrustworthy for legal testimony, and would undoubtedly be inadmissible as evidence in a court of law. Assuming, however, that the results are accurate, and that every reliance can be placed on the proportions of organic carbon and organic nitrogen obtained by the process, it is evident, on the showing of Dr. Frankland, that the results are of no value in determining the quality of the water, for they give no indication whatever of the state or form in which the organic matter exists in the water. Organic carbon and organic nitrogen, or the organic matter which yields them, is not necessarily injurious to health. They are, in fact, in our food, the wholesome agents of nutrition; and unless we can learn something of the state or condition in which they existed in the water, the knowledge of their proportions is of no value to us. Dr. Frankland, himself, admits this, and says that we must look further for an answer to the question. He says, indeed, speaking, I presume, of his own process, that chemistry alone is powerless to distinguish between wholesome and unwholesome water. This, however, I do not admit; for the albuminoid ammonia test of Mr. Wanklyn, and the cold permanganate test, which I and others are in the habit of using, are both capable of showing the condition of the organic matter, even when they do not determine the total proportions of organic matter; for it is chiefly the decomposing and decaying organic products which are betrayed by these agents. In these respects, therefore, these processes are much more reliable and explanatory than Dr. Frankland's combustion process. And now with regard to Dr. Frankland's interpretation of his results. First among the headings of his tables is the phrase, "Total organic impurity," which he applies to total solid matter obtained on evaporation. [Here Dr. Frankland interposed, and said there was no reference in his paper to the total solid impurity of water, but that his remarks were confined to the process of analysis, and not to the phrases referred to; whereupon Dr. Letheby replied that the discussion of the process would be imperfect and incomplete if it did not include the language used in the interpretations of the results; and he said this was the expression invariably used by Dr. Frankland in all his reports from the month of March, 1867, when he first employed it in the returns of the Registrar-General, and he (the speaker) maintained that it was an improper phrase, as it did not express a fact, but an opinion, which was sensational and alarming, and which had been severely condemned by the Royal Commission on Water Supply.] I will, however, pass from that, and go to another phrase which is even more objectionable—namely, the phrase of "Previous sewage contamination"—which Dr. Frankland applies to the nitrogenous constituents of water. That phrase, like the last, dates from the month of March, 1867; from which time to the present he has contended that, with certain corrections, the total nitrogen in natural waters might be ascribed to previous sewage contamination, and might be expressed in parts of average filtered London sewage—10 parts of combined nitrogen in 100,000 parts of sewage being taken as the average of such sewage. Now, I object to this phrase upon two grounds—first, it is obviously incorrect; and, secondly, it is unduly and improperly alarming. It is incorrect, because, as everybody knows, the nitrogen of water is derived from other sources than sewage; for not only is it frequently in rain water in much larger quantities than Dr. Frankland assumes, but it is often derived from decaying vegetable matters, and from the nitrogenous matters formed in the porous strata of the earth—especially in chalk. In illustration of this, I may say I have for some time past been examining, month by month, the quality of the water of the Nile, taken about 400 miles above Cairo, where there could be no sewage or drainage—except the sewage of hippopotami and alligators, if it might be so called—and it was as full of organic nitrogen as the worst of the London waters, and would be condemned by Dr. Frankland as full of present as well as previous sewage contamination, and, therefore, wholly unfit for domestic use. The natives of the country, however, have no such fancies, but call it, by pre-eminence, "sweet water," and drink it, sedimentary matter and all, with the greatest gratification and benefit. Even as regards the water supplied to this Metropolis, the phrase is quite inaccurate, and requires explanation to prevent alarm. In the case of, for example, the water derived by the Kent Company from deep wells in the chalk, which generally, according to Dr. Frankland, contains considerably more previous sewage contamination than any other of the waters supplied to this Metropolis—it is necessary to qualify the phrase by saying that, by gradual oxidation, this sewage or animal contamination had been, so far as analysis can show, converted into innocuous inorganic compounds. But why create a difficulty, as he does, only to overcome it? Why, indeed, excite unnecessary alarm in the public mind, only to quell it? It is like the cry of "Wolf" in the fable, which at last was disregarded. Speaking on behalf of a cause in which I have been actively engaged for more than a quarter of a century—I mean the cause of sanitary science—I do protest against the use of such sensational phraseology, as dangerous to its welfare; for when the public perceive that these continued surprises are but false alarms, and are not followed by the terrible consequences which are so confidently predicted, they will be apt to judge of all our warnings in like manner, and to treat us with unqualified contempt. I have much to say on the subject of the disappearance of organic matters during the flow of them in rivers, and in which I am entirely at issue with Dr. Frankland; but as this did not come immediately within the scope of the paper, I will not detain the society by any observations upon it.

Dr. TIDY did not think there was much force in the objection to Dr. Frankland's process, that it takes much time and trouble; for if it gave accurate results such a question ought never to be raised. But did it give accurate results? He said he had made 68 determinations by the process, and then proceeded to give an account of the results he had obtained with it, from which it appeared that in 16 cases out of 28 he had obtained nearly double the amount of carbon he ought, and the nitrogen determinations were equally unsatisfactory, although every care had been taken in the evaporation. He had also found great practical difficulty in detaching the residue from the capsule, and in keeping out dust, &c. With regard to the albuminoid process, he must express his regret that Mr. Wanklyn had not published an extended list of carefully collected details of experiments, as he had found not only that the whole of the nitrogen was not obtained, but that the presence of chlorides certainly affected the results. They were told to distil the permanganate solution until ammonia ceased to be given off, but if they then left it for a day, and again distilled, they would again get ammonia, and the next day more. Notwithstanding this, it certainly gave results which had some relation to the amount of deleterious impurity present. A potable water, however, should be judged rather from a broad view of the whole of the results of the analysis.

Dr. RUSSELL said he had some little experience both with Dr. Frankland's and with Mr. Wanklyn's methods. There certainly were difficulties of manipulation attached to the former process, amongst which he might mention the obtaining pure copper oxide, and the assaying of it; but if the operations were carefully performed, accurate results would be obtained, although inconveniently large errors of observation might occur. The necessity of setting up a complicated apparatus militated against its use in laboratories where water analysis was only occasionally performed. The albuminoid ammonia process had come into general use from its comparative simplicity; the results obtained by it, however, should never be taken alone, but in conjunction with the amount of the chlorides and the remainder of the analysis, and the same might also be said of Dr. Frankland's process, for the question put to chemists practically amounted to this—Is this water fit for use? He thought the ammonia process the most convenient for general use, but when any special points were to be brought out they should fall back on the "combustion method," which was a most admirable scientific process, and had given some splendid and instructive information.

Dr. VOELCKER said he would leave no stone unturned to follow out Dr. Frankland's process if he could see what to do with the carbon or nitrogen when he had got it. But if he could do nothing with it, why should he go to so much trouble to ascertain its amount? Moreover, if the amount of carbon and nitrogen present was an indication of the impurity of the water, we should have to reject many waters of a peaty nature which were perfectly wholesome. He had adopted Wanklyn and Chapman's process, not because he considered the results obtained by it strictly exact, but because it gave extremely useful indications of the purity of a water when taken in conjunction with the other results of analysis. There was one point which had not been previously noticed, and which he might allude to, and that was the occurrence of notable quantities of phosphoric acid, as phosphate of lime, in waters which were decidedly unwholesome, generally associated with albumenoid ammonia, chlorides, and alkaline carbonates. If such a water were filtered through a soil, the phosphates would be removed, but not if it had merely trickled through fissures in the ground; so that a well water which contained phosphate might be considered unwholesome, and exhibiting actual sewage contamination. With regard to "previous sewage contamination," he agreed entirely with the remarks made by the President and by Dr. Letheby, and hoped Dr. Frankland would consider it desirable to abandon the expression, "previous sewage contamination," in his water reports.

Dr. BISCHOFF considered that although the albumenoid ammonia process had the advantage of simplicity of manipulation, it was not, strictly speaking, a quantitative method, and the results obtained by it were often fallacious. When examined by this process, a pure water mixed with 0·01 per cent. of urine would be considered wholesome, and he (Dr. Bischoff) quoted numbers obtained by two Scotch chemists which were anything but concordant. He had also made experiments with the water of Loch Katrine by Frankland's process, which gave 0·162 carbon and 0·024 nitrogen. On adding variable quantities of nitrates to this, and evaporating, he had obtained the numbers 0·140 carbon and 0·020 nitrogen in one instance, and with a larger proportion of nitrates the numbers 0·170 carbon and 0·018 nitrogen.

Mr. W. THORP said that, having had charge of the laboratory of the Rivers Pollution Commissioners throughout the inquiries of both commissions, he had had a large practical experience in the matter of water analysis, having collated the results of some thousands of determinations made by himself and three or four colleagues. After having ample opportunities of testing most of the methods of analysis which had been proposed, including that of Messrs. Wanklyn, Chapman, and Smith, he felt thoroughly convinced of the accuracy and practical value of the combustion process of Drs. Frankland and Armstrong. He had been rather amused at the doleful description of the difficulties of that process given by Dr. Letheby and Dr. Tidy; for instance, the removing the water residue from the capsule. This, he could say, had never been felt at the laboratory of the Rivers Commission, except in a few instances—when waste products from factories had to be dealt with instead of water. The combustion process did what no other process did, and that was, give the relative proportion of carbon and nitrogen. This ratio was of the utmost importance in forming an opinion on the nature of a water. With regard to the term, "previous sewage contamination," most of the mistakes arose from a misunderstanding of plain English—by confounding it with actual or present sewage contamination. But while he thoroughly endorsed the use of the term in its true meaning, he thought that another phrase might be employed which would be less likely to be misunderstood. Since the time when Messrs. Hofmann and Blythe, and Way and Ogston, made the analyses of London sewage, from which the standard average value was deduced, the strength of the sewage had been much diminished, and since the assumed value had now no reference to the actual value, the expression of analytical results in terms of London sewage was merely conventional, and any system which gave a numerical value for the quantity of nitrogen in the water, which had previously been present in the form of organic matter, would be equally useful. He suggested the term "mineral combined nitrogen," or, shortly, "mineral nitrogen," to denote the sum of the nitrogen present as ammonia, nitrates, and nitrites. This would be based on the facts ascertained in the analysis, and would involve no theory whatever. It might be objected that this would be incomprehensible to all except analysts; but he thought that the statement of the numerical results of an analysis should be intended only for the information of the profession, and that the accompanying report and opinion of the analyst should alone be addressed to the public. If his suggestion were adopted, the small correction for nitrogen present as nitrates, nitrites, and ammonia in rain water which was made in calculating the "previous sewage contamination" would be discontinued; but this was exceedingly small (·032 part per 100,000), and its omission could not, in any case, affect the opinion of the analyst as to the quality of a water. He also suggested that "nitrogen as ammonia," or "ammoniacal nitrogen," should be reported instead of "ammonia." No additional calculation would be involved, as the standard solution of chloride of ammonium could be made stronger in the proportion of 17 to 14. This nitrogen would then be uniform with that reported as "organic nitrogen," and "nitrogen as nitrates and nitrites," and the multiplication by ⅓ which had now to be made to ascertain the quantity of nitrogen present in the ammonia in calculating the "previous sewage contamination" or "mineral nitrogen" would be avoided.

Dr. ARMSTRONG desired to make an observation or two on the sources of error in the combustion process. The loss by evaporation had been much exaggerated. As now performed, under a glass shade, in a reducing atmosphere containing sulphurous acid, oxidation would be reduced to a minimum, and Pasteur had shown that, on exposure to the air of organic matters, but little action took place at the ordinary temperature, even in three years; the absorption of oxygen which usually takes place being due to the presence of living organisms. At the high temperature of the water during the evaporation this cause could not operate. Again, as far as our knowledge of the splitting up of albuminoids under the influence of dilute acids extends, they appear to yield bodies even more stable than the original substances, and therefore not likely to be affected by the evaporation.

After some remarks by Dr. DUPRÉ and Mr. FRISWELL,

Professor WANKLYN observed that the ammonia process was not properly worked unless the water was completely exhausted, and where time was an object, it was advisable to operate on a comparatively small quantity when the water was of this character. One of the merits of the ammonia process was that it concentrated the ammonia, and thus rendered evident very minute quantities of albumenoid substances.

Dr. FRANKLAND, replying to the various speakers, said he would make his remarks as brief as possible. With regard to Mr. Wanklyn's objection to the process on account of the difficulties of manipulation, he was afraid the objector still belonged to the number of those who had not tried it, and whose objections were purely theoretical, for he seemed to imagine that the errors incident to the determination were the same in amount as those of an ordinary combustion, but this was not the case. In the original experiments, where the determinations were made with comparatively large quantities of organic matters, the error was found to be about 1-20th, and although even this was of no moment in forming an opinion about a water, yet subsequent experiments had shown that this error was not maintained when smaller quantities were operated on. With very small quantities, results were now obtained within 1-44th of the whole organic elements present. The comparative error must be looked at in as far as it affects the chemist's opinion of the water. With regard to the possibility of a minute portion of the nitrates escaping destruction in the evaporation of the water, the original experiments of Dr. Armstrong and himself showed that this was not the case, as did also the analysis of certain waters which contained nitrates, but which gave no organic nitrogen on combustion. Again, Professor Bischoff's experiments with the Loch Katrine water proved that the artificial addition of nitrates did not interfere with a correct determination of the organic carbon and nitrogen, a conclusion which might also be deduced from the results of the analyses of the Thames waters—for example, in summer, when the amount of nitrates varies most, the organic elements remain about the same, whilst in winter, when the nitrates are nearly constant, the organic elements vary between wide limits. This the speaker illustrated by the numbers obtained with five of these waters in 1870. In order to obtain some evidence of the extent of the oxidation which might take place during evaporation, he had repeated the sawdust experiment referred to by Mr. Wanklyn at the last meeting, but after passing air over it for two whole days, at a temperature of about 70° C., he had only obtained mere traces of carbonic acid. All the recent experiments on putrefaction tended to show that the development of carbonic acid was due to the presence of germs, and at 70° or 80° C. these germs would be destroyed. Moreover, the organic matter during evaporation was protected from oxidation by the sulphurous acid added to the water. The amount of ammonia obtained from a water by the albuminoid process had little or no bearing on the subject of its quality, as it was found that waters, as those of a peaty nature, where one would expect little, gave the largest quantity. Mr. Wanklyn himself had found the Bala Lake to give 0·25; Loch Katrine, 0·08; whilst the Thames only gave 0·06; making the Thames water appear the purest. The speaker then proceeded to animadvert on Dr. Letheby's departure from the meeting, which he said prevented him from criticizing his remarks so strongly as he otherwise would have done; he especially alluded to his adherence to the method of estimating the amount of organic impurity present in a water by means of a solution of permanganate, and to his opinion that the evidence of pre-existing sewage contamination was of little or no moment. The estimation of organic impurity by the permanganate method had been demonstrated to be utterly fallacious eight years ago; and yet Dr. Letheby, though unable to defend it, continued to use it in his analyses made for the Medical Officers of Health. He would also reply to Dr. Voelcker's observations, that by means of the combustion method, in a very large number of cases, at all events, he could most positively detect the difference between contamination by vegetable or animal matters, and hoped shortly to bring this important matter before the notice of the society. After referring to the formation of sulphuric acid from the sulphurous acid during evaporation, which he said would not have any such effect as that attributed to it by Dr. Letheby, he stated the reasons why he had adopted the term, "previous sewage contamination," he concluded by saying he quite agreed with the president that the importance of judging of a water by all its antecedents could scarcely be over-rated.

ON THE DECOMPOSITION OF NITRATE OF AMMONIA BY HEAT, AND ON THE VOLATILITY OF AMMONIACAL SALTS.

By M. BERTHELOT.

[From the *Comptes Rendus de l'Académie des Sciences*, April 24, 1876.]

Having had occasion to make some experiments upon the decomposition of nitrate of ammonia by heat, I observed certain facts which seemed to me not without interest, from the point of view of chemical mechanics.

Nitrate of ammonia melts at about 152° C., a temperature which the water pre-existing, or formed by the decomposition of the salt, does not permit of being more exactly determined. It is only from 210° C. that it begins to decompose sufficiently to furnish an appreciable volume of gas in a few minutes. This decomposition becomes more and more active in proportion as the temperature of the fused salt is raised by a supply of heat, unless the temperature is checked at some fixed point between 200° and 300° C.* If the heat is further increased, the reaction becomes explosive.

These characters are those of an exothermic decomposition, which agrees with my calorimetric experiments, according to which the calculated formation of protoxide of nitrogen, $N O_6 H$, $N H_3$ fused $= 2 N O + 2 H_2 O_2$, gas liberated about + 46 cal.

However, according to my experiments, the quantity of protoxide of nitrogen obtained is always very much lower than the theoretical amount, because of the real or apparent volatility of the nitrate of ammonia. The difference is even very considerable, if the operation is conducted at the lowest temperature, and in a manner to prevent as much as possible the portions sublimed in the cold parts of the apparatus from falling again in proportion in the warm parts at the same time as the condensed water.

Nitrate of ammonia may, moreover, be sublimed, without notably destroying it, by placing this salt, previously fused, in a capsule closed by means of a leaf of blotting paper, surmounted by a cylinder of cardboard filled with large pieces of glass. This is heated in a sand bath, care being taken that the temperature of the melted salt (indicated by a thermometer plunged into it) does not exceed 190° to 200° C.; a very considerable proportion of the salt is then sublimed in beautiful crystals, which attach themselves to the sides of the capsule and to the lower surface of the paper. A portion even passes through it, and is condensed on the other side in the form of white smoke, very much divided, and very difficult to collect. I have verified its identity with nitrate of ammonia by a complete analysis. The temperature of the paper thus traversed by the vapour may rise to beyond 120° and even 130° C. (indicated by a thermometer placed upon the upper surface of the paper), without the paper being notably changed.

I attach a certain interest to this experiment, as being a suitable one for demonstrating that nitrate of ammonia may be volatilized in a natural state without having been previously decomposed into ammonia and gaseous nitric acid ($N O_6 H + N H_3$), which would recombine later on, their mixture dissociated possessing all the energy of the isolated components. In fact, we are unable to understand how the vapour of monohydrated nitric acid could be found in contact with the paper, at a temperature necessarily comprised between 130° and 190° C., without oxidizing it or destroying it instantaneously.

* In producing a momentary stoppage in the heating, it is easy to cause a suspension to the liberation of the gas, followed, on a subsequent heating, by phenomena analogous of those presented by a liquid superheated above its normal boiling point.

BERWICK GAS COMPANY.—The annual meeting was held on the 20th inst.—Alderman Young in the chair. From the accounts presented it appeared that the receipts for the past year amounted to £4818 14s. 4d., and the expenditure to £3634 7s. 4d., leaving a net profit of £1184 7s. A dividend at the rate of 10 per cent. was declared.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The great depression of the leading trades of the town and district is beginning to excite the gravest apprehension as to the immediate future of not a few firms. There have already been a few failures, of no great moment, however, and names are being freely rumoured in indication of further stoppages. Some portion of these rumours may be premature or exaggerated, but I am afraid that in other respects they are but too well founded, and that during the next six or seven months we shall have to face a most serious state of things. It is, on all hands, acknowledged that no such depression has been current for a very long series of years, and that its effects are certain to be unduly intensified by the abnormal amount of competition recently developed

The iron trade is in a state of complete paralysis, hardly any of the local works having any orders on hand, and but few are in course of execution. Two or three of the merchant iron works are as nearly entirely closed as may be without stopping altogether. The merchants themselves say that there is absolutely no demand whatever, excepting now and then a small order for special brands of iron for specific purposes. Bars of common make can be had at under £7, good medium at £8 to £8 10s., and marked qualities at £8 10s. to £9 per ton.

The cast steel trade is in an equally despondent condition, matters being especially grave with one or two houses. There is no demand from the United States; indeed, careful observers, who have just returned thence, state that the trade of Sheffield with that portion of America is at an end, the producing powers of the native works being far in excess of the possible demand of several years hence-forward.

In the local and district fuel market the supply is three times the demand, so that there is a very lively competition for orders, and a good deal of cutting as to prices. Some of the collieries are being closed, and amongst the smaller merchants there is reason to fear failures. One, Walter Stovin, has already filed his petition with nearly £3000 liabilities. There is a fair demand for steam coal for exportation at 7s. to 8s. 6d. per ton, and a few gas contracts are being renewed at about these figures.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is very little change to notice in the position of the coal trade of this district, either with regard to demand or prices. In the gas coal trade, many contracts continue unsettled, but prices are about the same as those last quoted. The house coal trade is very slack, whilst the commoner classes of round coal meet with very little demand, owing to the present small requirements of iron manufacturers. For engine classes of fuel there is also less demand, as short time is now being largely adopted in Lancashire, but supplies of this class of fuel are not very large, and good slack is generally steady in price. Stocks are increasing to a considerable extent in the Manchester and neighbouring districts, and where sales are pressed, as is the case with some of the small concerns, concessions have to be made; but the large proprietors, as a rule, maintain late rates. In the South Lancashire districts, reports from all quarters are that trade is extremely bad, but except in best coal very little is going down in stock, as the production in most cases is restricted to the orders on hand. The pit prices are about the same as those last given, and may be quoted as under:—Best Arley, 11s. to 11s. 6d; common ditto, 9s. to 9s. 6d; Pemberton four-feet, 9s. to 9s. 6d; ordinary Wigan screened gas coal, 8s. to 9s; common coal, 7s. to 8s.; burgy, 5s. 6d. to 6s; and slack, 3s. 6d. to 4s. 6d. per ton.

In the shipping trade there have been a few more inquiries, but prices continue low and unremunerative.

Notwithstanding the agreement to accept the reduction of 15 per cent. in South Lancashire, many of the men have been away from work during the past week, and considerable inconvenience has been caused to colliery proprietors in some quarters.

In the iron trade there has again been very little doing either in raw or manufactured articles. Makers of Lancashire pig iron would be sellers at about 56s. 6d. to 57s. per ton for No. 3 foundry, and 55s. to 56s. per ton for No. 4 forge, delivered into the Manchester district; but buyers cannot be found at these figures. Middlesbrough iron delivered here is offered at 53s. 9d. per ton for No. 3 foundry, 51s. 9d. for No. 4 foundry, and 50s. 3d. for No. 4 forge. Finished iron is rather easier, and quotations for ordinary bars delivered here range about £7 2s. 6d. for Sheffield and Staffordshire, and £6 17s. 6d. to £7 per ton for Middlesbrough and Lancashire ditto.

The Wigan Coal and Iron Company have blown out another of their furnaces, thus making six out of ten which are now out of blast, and in other branches of the iron trade in this district men have been discharged in large numbers.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of the North of England was not quite so steady last week. The price of best steam coals was fully sustained, but second-class coals hung in the market. Gas, coking, and manufacturing coals were extremely quiet, and prices had a tendency downwards. The shipments of gas and the inferior class of household coals were very large last week, but a considerable quantity of lower-class coals were sent to the Continent upon consignment, which kept second-class household and gas coals at a low figure. The pits, however, are very well employed. The price of gas coals continues to range from 9s. 6d. to 6s. 6d. per ton. Inquiries about contracts were made by gas companies last week, but no very large transactions were entered upon. There were disquieting rumours from the Cleveland district last week, and, if matters had not been arranged, the iron trade of the county of Durham, no doubt, might have drifted into a very unsatisfactory condition indeed. Happily, the threatened mischief was tided over, and affairs, if they were no better last week, were no worse than they were the week before.

Shipping business is dull. Freights are without general improvement. A slight demand sprang up for Italy last week, which was filled by steamers. Cronstadt rates are well maintained, but for the lower ports they are worse. Coasting business is very bad, and rates are lower than ever. To London, for steamers, they were quoted at from 4s. to 4s. 3d.; Rochester, 4s. 3d. to 4s. 6d. per ton; Hamburg, £5 17s. 6d. to £6 per keel; Dieppe, 6s.; Rouen 7s. 6d. per ton last week.

The general manufacturing trade of the Tyne, like the Durham coal trade, was very unsettled last week, and from the same cause; for, if the catastrophe, which at one time seemed to be inevitable, had been precipitated, though to some extent the financial difficulties of the house had been discounted, so many other establishments would have been involved, that the effect would have been tolerably far-reaching. Another thing keeps business down. Some of the Russian trade seems to be a little unsound, and, generally speaking, there appears to be a want of confidence at this time, which makes business men more careful than ever in their operations. The Cleveland iron trade shows no improvement, and the report of last week was simply a counterpart of the week before, and many weeks before that. Somehow or other, the Cleveland iron trade is very deficient of vitality at present. It hangs on from one week to another in pretty much the same state, and without improvement. The chemical market was no worse last week than it had been. A fair quantity of bricks and fire-clay goods were shipped, but, at the best, the outward goods trade was very poor.

The labour market is more overstocked at present with unemployed men than it has been for several summers past, and wages have a tendency to get lower.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

In the last monthly report of Mr. Whimster, manager of the Perth Gas-Works, it was stated that the increase in the quantity of gas made over the production of the month of June, 1875, was 6·8 per cent., and that the illuminating power was—maximum, 27·6 candles; minimum, 27·4; and average, 27·5 candles.

At the annual meeting of the Kirkcaldy Gaslight Company, held on Wednesday, the 19th inst., the statement of accounts submitted showed a surplus (after paying the dividends) of £700, and it was agreed to reduce the price of gas from 5s. to 4s. 4½d. per 1000 cubic feet, the reduction to take effect from the last survey of the meters. The illuminating quality of the Kirkcaldy gas generally ranges from 28 to 30 candles.

The 24th annual meeting of the Cumbrae Gaslight Company was held on the evening of Friday, the 14th inst., when the usual reports were submitted from the directors, and, on their recommendation, a dividend of 7½ per cent. on the original stock was declared.

At the last meeting of the Town Council of Aberdeen, Professor Brazier's report on the quality of the gas supplied by the Gas Commissioners during the preceding six months was submitted by the Gas Committee. During that time the examiner had made six visits to the works, and on each occasion had tested the gas twice. The mean illuminating power on those occasions varied from 30·03 candles to 30·46 candles. The gas had been tested several times for sulphuretted hydrogen, ammonia, and carbonic acid. Sulphuretted hydrogen was not detected on any occasion; there were slight traces of ammonia upon one or two occasions, and, in the more recent occasions, slight quantities of carbonic acid were found.

The annual meeting of the Laurencekirk Gas Company was held on Wednesday week. From the balance-sheet it was shown that the affairs of the company were in a prosperous state; and it was unanimously agreed that, after clearing off the balance of debt incurred by recent improvements on the works, and paying a dividend of 7½ per cent. to the shareholders, the price of gas should be reduced from 10s. to 8s. 4d. per 1000 cubic feet, while the street lamps should be supplied free of charge, as formerly.

The Kirriemuir Gas Company have just held their annual meeting, on which occasion they declared a dividend of 6 per cent., and agreed to reduce the price of gas from 8s. 4d. to 7s. 6d. per 1000 cubic feet. There was an increased consumption of gas during the past year. An increase was made to the manager's salary.

A reduction in the price of gas has been made at Pittenweem from 8s. 4d. to 7s. 6d. per 1000 feet, and the shareholders of the company have received a dividend of 8 per cent., besides adding to the contingent-fund and increasing the salary of the manager.

The dividend declared at the annual meeting of the Dysart Gaslight Company recently held was 7½ per cent., and the price of gas was reduced from 7s. 6d. to 6s. 8d. per 1000 feet.

A similar reduction in price has been made by the Anstruther and Cellardyke Gas Company; and, besides making a large addition to the reserve-fund, they declared the usual dividend of 8 per cent. At the annual meeting of the last-named company the resignation of the manager, Mr. John Adamson, after giving efficient and faithful service for nearly 32 years, was accepted, and it was left to the directors to recognize that service by the presentation of some suitable testimonial.

At the last meeting of the Town Council of Ayr the provost stated that Mr. Gale, C.E., engineer to the Glasgow Corporation Water Commissioners, had made a most thorough examination of the whole system of the town's water supply, and more especially as to the distribution of water for fire-extinguishing purposes. Mr. Gale had been accompanied in his work by the committee, appointed by the council, and every facility was afforded him of acquiring all the information necessary to enable him to understand the works thoroughly, to be in a position to give an exhaustive and authoritative report. Till his report is received nothing further will be done by the Town Council.

On Thursday evening the Paisley Water Commissioners had their statement of accounts under consideration for the year ending the 28th of May last. The total revenue was shown to be £11,476 5s. 3d., and the total expenditure amounted to £11,501 8s. 5½d., thus showing an excess of expenditure over revenue of £25 3s. 2½d. Under the head of expenditure there were included £500 set aside for the sinking-fund, and £425 7s. as expenses incurred in connexion with the new water bill. The balance account showed that there had been set aside £1200 to meet anticipated expenditure for the next year.

The shareholders of the Montrose Gaslight Company held their annual meeting a few days ago. From the annual report it appeared that the consumption of gas during the past year had greatly fallen off, and in consequence of that fact, and the leakage caused by the drainage operations throughout the town—estimated at £200—the dividend upon the £40 shares was fixed at £2 per share, in place of £3 as for many years previously.

The Police Board of Greenock, as the Gas Commissioners, have contracted for 5000 tons of "Wee Lesmahagow" gas coal, 5000 tons of Bank coal, and 10,000 tons of Tannochside coal, delivery of the latter to extend over 15 months from the 1st of July. Their annual financial statement was submitted to a meeting held last Tuesday. It showed that the gross profits for the year 1875-76 amounted to £14,923 11s. 4d., of which £2000 were paid to the Police Board, and £2866 2s. to the contingent-fund. The total revenue was £38,154 11s 4d, and the total make of gas was 151½ million cubic feet, of a very high illuminating power—over 30 standard candles on an average during the whole year, and about 32 candles during the winter months. At the meeting referred to, it was unanimously resolved to reduce the price of gas from 5s. to 4s. 7d. per 1000 cubic feet. The mean of 27 experiments made on the gas during the month of June showed the average illuminating power to be 28·93 candles, the maximum being 30·66 candles.

Dr. Wallace's report on the Glasgow gas for last week shows the maximum over the four stations to have ranged from 26·86 candles (at Dawsholm) to 29·33 candles (at Tradeston). The Dalmarnoch gas only was tested for impurities. It contained 14·19 grains of sulphur per 100 cubic feet, and ·15 grains of ammonia in the same volume of gas.

The works for the introduction of a new water supply into Inverurie are being vigorously pushed forward by the contractors.

Rapid progress is being made with the new water-works for the town of Hamilton. It was recently reported that there was at least 100 days supply in store in the large reservoir at Wellbrae.

It is expected that next year's expenditure by the Dundee Water Commissioners will amount to £32,625, and the revenue to £32,737 4s. 2d., showing an apparent surplus of £112 4s. 2d. The commissioners have resolved to borrow £60,000 to meet the requirements of the current year, and have retained the domestic water-rate at 1s. 1d. per pound.

A dividend of 5s. per cent. has lately been declared by the Markinch Water Company. Last year only 1 per cent. was obtained by the shareholders, and for many years no dividend was paid.

Messrs. James Leslie and Son, civil engineers, Edinburgh, have been requested by the Galashiels Town Council to proceed with the new water-works provided for by the Act of Parliament lately passed.

On the 1st of July there were 375,851,819 cubic feet of water in store at the Greenock Water Supply Works, or 107 days supply for all purposes. The accounts of the Gryffe scheme, which have just been closed, show that the total cost was about £145,000.

On Tuesday last the price of No. 1 Coltness and No. 1 Shotts was reduced 2s.

per ton. The warrant market was very strong at the opening on Wednesday forenoon, and as high as 56s. 10½d. and 57s. cash was paid, sellers at the close asking 57s. 1½d. Prices were rather easier on Thursday, and on Friday the highest price paid was 56s. 6d. cash.

The Glasgow Fair holidays have interfered with the production of coal, but there is no change or appearance of better trade. However, a good part of the dullest season is past, and a moderate revival may possibly be looked for shortly.

ALFRETON WATER SUPPLY.—The Local Board of Alfreton are about to apply to the Local Government Board for power to borrow £25,000 for the execution of their water-works scheme, the estimated cost of which is £21,301 16s. 11d.

COAL CONTRACTS IN FRANCE.—The French trade journal, *Le Charbon*, states that a contract for 500,000 tons of coal has just been concluded by the Paris Gas Company with a Prussian coal company. Previously a good deal of the coal used by the Paris Gas Company was supplied from England, and it is stated that this is the first time the contract has gone to Germany. *Le Charbon* also says that it is proposed to substitute French for English coal in the national navy of France.

NEW ROMNEY GAS COMPANY, LIMITED.—At the annual general meeting of this company, on the recommendation of the shareholders present, the directors presented the manager, Mr. P. Seaman, with the sum of £5, as a mark of their appreciation of his energetic efforts on behalf of the company during the time he has been their manager.

BOSTON GAS COMPANY.—The annual meeting was held on the 20th inst.—Mr. J. W. Sharp in the chair. The net profit for the past year was announced as £4064 8s. 10d., being an increase of £1124 0s. 11d., as compared with the preceding year. The directors recommended that the full parliamentary dividend should be paid on both classes of shares, clear of income-tax. A proposition to reduce the price of gas from 5s. 6d. to 5s. was discussed; but it was ultimately resolved that the price should remain as it is until May next.

HUDDERSFIELD CORPORATION WATER SUPPLY.—At the meeting of the Huddersfield Town Council on Friday last, it was resolved to fix the corporate seal to mortgages for loans amounting to £15,000 on water-works account, and also to a mortgage deed for securing the sum of £100,000 to be advanced by the Lords of the Admiralty to the corporation, for the term of 30 years, for water-works purposes, with interest thereon at the rate of 4 per cent. per annum.

Register of New Patents.

1194.—BABLON, V., Paris, "*Improvements in apparatus for regulating the flow of lighting gas, as well as for regulating the delivery of liquid and fluid substances of all kinds.*" Patent dated April 2, 1875.

This apparatus consists of a vertical cylinder provided with lids at the top and bottom; these are both pierced to allow of free passage to the gas; the top lid, however, is pierced laterally, leaving the centre solid. Beneath the upper lid is a fixed division in which a piston moves without friction, and when in repose rests on the rim of the lower lid; to this piston a hollow shaft is connected and extends above it, and debouches just above the fixed division through which it passes without friction.

The object of this arrangement is as follows:—The gas coming from the main, beneath the piston, surmounts it, flowing partly round its sides and partly through the hollow shaft, if not closed by a plug with which its lower part is provided. The gas, having reached above the piston, enters the hollow shaft through side openings made therein beneath the fixed division, and escapes at the upper end of the shaft above the division, and thence presents itself to the burner or burners fed by the apparatus. The piston is more or less raised according to the pressure of the gas delivered from the main, which has the effect of raising the shallow shaft towards, or lowering it from, the solid part of the upper lid, thus automatically opening or closing the upper part of the hollow shaft, and so regulating the delivery of gas to the burners. The central or solid part of the upper lid is slightly hollowed, so that the hollow shaft in rising slightly engages therein in closing; this renders the closing of the valve more gentle and progressive, and so prevents the vibrations to which the valve would be subjected in closing too abruptly. The quantity of gas or fluid delivered by this apparatus depends on the size of the orifice offered to it through the piston, as well as in the weight of the whole moveable part which the gas or fluid raises.

1197.—STUTTLE, W., Shrewsbury, "*Improvements in gas-brackets.*" Provisional protection only obtained. Dated April 2, 1875.

An improved gas-bracket is described having two double elbows on the upper portion thereof, which is connected with the gas-pipe; to each of such double elbows an ordinary gas-tap is fitted, one of such taps serving to keep the flame at its minimum height, and the other being regulated by a lever, cord, and pulley connected thereto. Upon pulling the cord the gas is instantly turned on, and when it is desired to reduce the light it is only necessary to slightly lift the pull or balance-weight attached to the lever, when the flame is instantly diminished.

1209.—BREEDEN, J., Birmingham, "*Improvements in sliding chandeliers and gaseliers.*" Patent dated April 3, 1875.

This invention consists in connecting the several weights by which the chandelier or gaselier is balanced, to a ring or common junction piece, so that if one of the chains of the weights breaks, the said weight does not become detached from the chandelier or gaselier. This invention consists further in preventing the sliding part of the chandelier or gaselier from falling in case of the breaking of the chains, by making ribs or projections on the fixed tube, and a slot in the cover of the water-cup, or the top of the sliding part of the chandelier or gaselier, and a like slot in the screw-cap of the same, for permitting of the introduction of the fixed tube into the sliding tube. These slots are made to cross, so that on the descent of the sliding part of the chandelier or gaselier, the latter is arrested by coming against the tops of the ribs or projections on the fixed frame.

1210.—SOUTHBY, A. G., Westminster, "*Improvements in stoves for boiling and heating by gas.*" Provisional protection only obtained. Dated April 3, 1875.

According to this invention the gas is burned in a chimney of a shape to suit the shape of the flame or flames. The air is admitted freely at the bottom of the chimney for the combustion of the gas, and the bottom of the pot or utensil to be boiled or heated is supported over the top of the chimney, so as to allow only a space of less than one-quarter of an inch between it and the top of the chimney; burning only so much gas in the chimney, the products of the perfect combustion of which can escape through such space; making the chimney tall enough for the flames not to reach to the top of it.

1211.—SOUTHBY, A. G., Westminster, "*Improvements in the mode and apparatus for supplying gas-stoves with gas.*" Provisional protection only obtained. Dated April 3, 1874.

In carrying out this invention the gas-stoves are connected with the burner nibs used in gas lighting by means of a cast, bent, or elbowed hook-shaped pipe, made of some stiff material, with one arm a little longer than the other. The hook-pipe is made small enough to pass freely up into the gas globe through the air opening at the bottom, and the shorter arm is connected to the burner nib by means of a short length of elastic pipe fastened to the arm and brought down over the nib. The longer arm of the hook is connected with the gas-stove by flexible pipe.

1233.—HELLIER, H. G., Brixton, "*Improvements applicable to or connected with lamps and other light suppliers and burners, and apparatus through which gas is supplied to burners.*" Provisional protection only obtained. Dated April 5, 1875.

This invention mainly consists in the use of carbon, or carbon combined with cotton pulp, asbestos, whiting, pipe-clay, chalk, putty, pumice-stone, lime, fullers-earth, plaster of Paris, or suitable materials, in forming a wick where a light is required, as in lamps used in the combustion of oils, being also applicable to a candle or night light where the cotton wick is replaced by wick made of carbon or carbon combined as above. In gas-burners the burner is supplied or filled in with carbon or the combination, or the carbon is placed at the meter so that the gas for combustion passes through same, and thence to the burner.

1235.—PULFORD, G. C., London, "*Improvements in glass reflectors or radiators for gas, oil, and other lamps or burners.*" Patent dated April 5, 1875.

This invention relates to improvements in glass reflectors or radiators for gas, oil, and other lamps or burners, and consists in moulding or otherwise forming ribs or flutes, plain or zig-zag, of ring shape in or upon the outside only, or upon the outside and the inside of chimneys and globes. The ring ribs or flutes and hollows may have angled faces with under cut like shoulders, or they may be like ordinary corrugations, the object being in this invention to take up the rays of light by the angled faces, and to distribute or radiate some of the rays in rings radially, and to concentrate and to throw down other rays in proximity to the lamp. The glasses, which may serve as ordinary gas or lamp chimneys or globes, can be ring fluted or corrugated for the whole or only for a part of their lengths or heights.

1270.—ROBERTSON, J., Glasgow, "*Improvements in water-meters.*" Patent dated April 8, 1875.

This invention consists mainly in improvements in the form of water-meter for which letters patent were granted to the present patentee, Nos. 3146 (1868) and 448 (1873).

The first improvement consists in forming the piston and cylinders with induction and eduction ports at each end. The operating gear is contained in the cylinder or a compartment attached thereto. The index is operated from an arm actuated by the piston. The second improvement consists in forming the cylinder and piston ports of a series of small holes. The third improvement consists in forming crank discs with two bushes, one for each piston arm; such disc being itself set in a bush. The fourth improvement consists in forming the port ends of smaller diameter than the piston proper. The fifth improvement consists in giving a compound motion to the piston by an arm working in an oval groove; weights or springs may be used to assist in passing the centres. The sixth improvement consists in giving the pistons, a complete rotary motion as well as a reciprocatory motion to the piston, and employing gearing to carry the pistons over the dead centres. The seventh improvement, consists in placing the connecting crank disc inside a compartment connected with the cylinders, thus dispensing with stuffing-boxes, and in combination with valves or concentric valves.

1367.—HARRIES, B., Landport, "*A new apparatus for gauging the supply of water when used for flushing closets, domestic or other purposes, in order to prevent waste.*" Patent dated April 15, 1875.

The advantages claimed for this invention are—1. That no ball cocks or screw taps are required, the water raising the valve of itself. 2. The supply being gauged by the action of the lever, this apparatus forming a complete water-meter. 3. By means of this apparatus there can be no possible means of waste. 4. The apparatus is so simply arranged that it may be fixed in a very short period of time, and in positions where an ordinary tank or cistern could not conveniently be placed.

1368.—SPENCER, T., London, "*Improvements in the purification of water and other fluids.*" Patent dated April 15, 1875.

The object of this invention is to consolidate granular magnetic carbide (used for the purification of water) into solid but porous magnetic blocks, of any shape, by treatment in an oven in mixture with flour, and then by increasing the heat to give the same coherence sufficient to render them applicable for portable and other filters. The means employed are also applicable to the consolidation of any ferruginous oxide or ferruginous refuse, and applicable to similar purposes.

1397.—MURDOCH, H. H., London, "*Improvements in treating and utilizing spent tan, and obtaining useful products therefrom.*" A communication. Patent dated April 16, 1875.

According to this invention the spent tan is dried and carbonized in retorts, in a suitable furnace; the gas evolved in the process is purified and refrigerated, and separated from its tar and other impurities by being made to pass through purifying apparatus, and is finally discharged into a holder or gasometer. The drying and carbonizing process in the retorts is promoted by a blast of air from a fan, which blows away the vapours emitted by the tan, or the vapours may be drawn out by suction, and the tan may be stirred up during the process by a revolving agitator, which agitator may also serve to convey the blast into the retort.

1491.—WILLIS, C., and PEARSON, W., Bradford, "*Improvements in double-acting pumps and pumping-engines for feeding steam-boilers and other purposes.*" Provisional protection only obtained. Dated April 23, 1875.

This invention relates to constructing pumps, having the barrel, valve-boxes, inlet and outlet passages cast in a cylindrical form, and forming one casting. The pump is worked by a steam cylinder, the piston-rod being connected to the pump-rod by a cross-head, to which is fitted a guide-rod working through guides fitted to the pump; a bracket is fitted to the guide-rod, to which is fitted one end of the connecting-rod, the other end being connected to the crank, allowing a long connecting-rod. The cylinder is supported on a pillar cast hollow, forming a chamber and air-vessel. The pump can be disconnected from the engine, and the engine used for other purposes.

1505.—COOK, H. W., London, "*Improvements in the method of and apparatus for purifying carburetted hydrogen gas.*" Provisional protection only obtained. Dated April 23, 1875.

The objects of this invention are to economize the chemical ingredients employed for the purification of gas. To this end the purifying materials (say lime, for instance) are presented to the gas in such a manner that they will act energetically on the gaseous impurities, and will offer continually fresh absorbing surfaces.

1514.—BONNEVILLE, H. A., Paris, "*An improved means of preventing the breakage of the glass chimneys of gas-burners or lamps and glass vessels of petroleum lamps, and the accidents resulting therefrom.*" A communication. Patent dated April 24, 1875.

The invention consists in enveloping the glass chimneys of lamps and gas-burners, and also the glass vessels of petroleum lamps, in a wire casing to prevent their breakage.

1581.—GODDARD, B., Southport, "*Improvements in taps or valves.*" Patent dated April 29, 1875.

A valve or tap, constructed under this invention, consists of two parts, the shank or pipe and the valve. The shank is taper and provided with two lugs;

a hole or way passes through the shank or pipe, and through one of the lugs. The hole through the shank or pipe is enlarged at the lug end to receive a screwed valve. The valve is provided with a pointed stem or spindle, which passes through the shank, and closes the aperture at the opposite end. The shank or pipe may be screwed, and the valve seating or valve may be tipped with leather or other material.

1599.—JENNINGS, J. G., Lambeth, and POCOCK, A.W., Westminster, "*Improvements in liquid-meters.*" Patent dated April 30, 1875.
The improvements relate to meters in which two cylinders are employed, with pistons working therein, and connected to two cranks on a shaft enclosed by hoods. The cylinders and hoods are cast in readily fusible metal in metal moulds, and an arrangement of meter to allow of this being done is described. There is also described an arrangement for giving motion to the registering index from the crank-shaft; also a means of making a tight joint between the eccentric and the valve to which it gives motion; also lining the cylinders and bearings with tubes of hard metal; also an arrangement for packing the pistons and for preventing water passing along the shaft in its bearings.

1626.—RHAMES, R. W., Tinahely, Ireland, "*Improvements in gas-burners.*" Patent dated May 3, 1875.
This invention consists in the employment in gas-burners of a gauge for regulating the amount of gas which flows through the burner. This gauge is a hollow cylinder, formed with longitudinal slits, through which the gas has to pass. The regulation is effected by screwing the cylinder more or less into a socket, so as to cover more or less of the slits. The invention also consists in the employment of a spherical or other form of chamber screwed on over the gauge; this chamber receives the gas as it flows through the slits, and it is provided with a lava tip or other burner.

1672.—WHITLEY, J., Roundhay, "*Improved mode of and arrangements for removing from sewers and dealing with deleterious gases.*" Patent dated May 5, 1875.
This invention relates to exhausting and purifying the deleterious gases in sewers by the application of heat in a shaft in proximity to a trunk sewer, a series of Bunsen burners or other mode of caloric force being arranged so as to heat the entire area of the shaft. The gases are caused to flow to the centre of heat, and in their passage through the flames become purified.

1694.—WHITLEY, J., Roundhay, "*Improvements in the purification of gas.*" Provisional protection only obtained. Dated May 6, 1875.
This invention describes a means of purifying gas by filtering it through layers of cotton wool or other fibrous material.

1729.—GORDON, J., Glasgow, "*Improvements in waste-preventing stop-cocks or valves.*" Patent dated May 10, 1875.
These improved stop-cocks or valves are of a self-closing kind, and a distinguishing feature of the improved construction consists in the valve-seat being moveable, and in its following the valve or closing detail, so as to become closed against it after a certain interval, even in its extreme position.

1752.—HALLSWORTH, S., Armley, and BAILES, R., Woodhouse Carr, Yorks, "*Improvements in purifying illuminating coal gas, and in the preparation of the means employed therefor.*" Patent dated May 11, 1875.
This invention consists in the employment—1st, of iron oxidized ore, residue of iron pyrites, residue of burnt or calcined alum shale; 2nd, of slaked lime and dry sawdust, with liquid from iron pyrites beds, or solution of copperas, or liquid remaining after crystallization of copperas, or from burnt alum or shale, to which is added ground iron ore, residue of burnt iron pyrites or calcined alum, or shale or spent oxide; 3rd, of dried copperas, or cooler bottoms mixed with lime and sawdust; and 4th, slaked lime and dry sawdust mixed with the ground iron ore.

1790.—JAMESON, J., and SCHAEFFER, A. G., Newcastle-upon-Tyne, "*Improvements in centrifugal pumps.*" A communication. Patent dated May 13, 1875.
This invention consists in employing a revolving chamber or drum so constructed as to give adequate rotary motion to the fluid to be pumped, and having central supply and discharge orifices; and within the revolving chamber, or drum, is affixed an internal stationary chamber or drum, inside which the fluid pumped is protected from the action of the rotating force applied to the revolving chamber. This internal chamber communicates by an opening or openings, in or near the circumference of the same with the interior of the revolving chamber before described, and externally through the central discharge orifice of the revolving chamber, with a central discharge-pipe in the line of the axis of revolution of the revolving chamber, to which revolving chamber the discharge-pipe is fitted by a stuffing-box and gland, or other arrangement to make it approximately water-tight.

1809.—PRIOR, M., Sheffield, "*Improvements applicable to compensating safety metallic pistons, valves, and anti-galvanic lubricant for same; applicable more especially to steam, water, air, or gaseous engines, to stuffing-boxes, to circular or piston valves, and to air and water pumps.*" Patent dated May 14, 1875.
This invention relates principally—1. To the use of curvilinear corrugated or zig-zag formed spring packing. 2. Covering or coating the spring packing with copper or other incorrodible substance, when used for pumps or other purposes. 3. Conformation of piston or packing rings, so as to securely embrace the spring packing. 4. Tongueing and slotting of joints or openings in spring packing-rings. 5. Anti-galvanic lubricant for the above and similar uses, being a mixture of fish or whale oil, mineral oil, iodine, talc, French chalk, soap-stone, asbestos, mica, and such like substances; all or some of them.

1816.—WALLACE, J., Seaham Harbour, "*A new and improved pump for pumping water, air, or gases.*" Patent dated May 15, 1875.
Inside a receiver and working within it is a hollow bottle-shaped barrel with cross-head, having attached an outlet piece with holes; under the barrel is a suction-pipe moving up and down over the holes inside, and also clock valve or clock ball. A fixed plunger and rod passing through two glands in connexion with the cross-bar above named, and over which the barrel moves. For water purposes a fixed pipe is used, the moveable suction-pipe working through the bottom end of the receiver and through a gland. For gases and atmospheric air alone the moveable suction-pipe without the fixed suction-pipe is used.

1848.—CLARK, A. M., London, "*Improvements in the method of impelling, conducting, or forcing air by the influence of a jet of air or steam, and in applying the same to various purposes.*" A communication. Patent dated May 19, 1875.
The invention consists in conducting, forcing, or impelling air by the aid of a jet of air, steam, or gas for producing combustion in furnaces, for ventilating buildings, theatres, hospitals, mines, and other like uses, and as a motive power.

1857.—TYLOR, A., London, "*Improvements in apparatus and arrangements for controlling, arresting, measuring, and recording the flow of liquids and fluids, and preventing the escape and waste of the same.*" Patent dated May 20, 1875.
This invention consists in constructing hydrants and apparatus for controlling and arresting the supply of liquids and fluids, so as to be easily accessible for examination and repair, and so as to prevent escape and waste of the same whilst being repaired, and applying means for preventing, as far as possible, dirt or grit from getting into the working parts. The invention also consists in arranging apparatus for measuring and recording the flow of liquids and fluids so as to employ a larger meter in conjunction with a small one, in order that the quantity passing through the large meter, which would be too small for an ordinary large meter of that kind to record, may, by passing through the smaller meter, be measured and recorded, which is facilitated and enabled to be done by the employment of the alternating or adjustable valves. The invention further consists in using "toughened glass" for all or any parts of the above apparatus.

1865.—MORGAN-BROWN, W., London, "*Improvements in photometers.*" A communication. Patent dated May 21, 1875.
This invention consists in measuring light by interposing one or several thicknesses of slightly opaque substances, as paper, carrying increasing numbers, by which figures the relative intensity of the light is measured.

1870.—HUGHES, R. H., Hatton Garden, London, "*Improvements in self-acting valves.*" Provisional protection only obtained. Dated May 21, 1875.
For the purpose of this invention, in the lower part of the cistern a valve-seat is placed; and employed in connexion with this is a valve, which has a tendency by its own weight to fall away from its seat; and connected to such valve by means of a chain is a float which acts to close the valve.

APPLICATIONS FOR LETTERS PATENT.

2814.—DAVEY, H., Leeds, "Improvements in compound pumping-engines." July 11, 1876.
2824.—LINFORD, C., Leicester, "Improvements in gas-engines, and in appliances connected therewith." July 11, 1876.
2831.—CLARK, A. M., Chancery Lane, London, "Improvements in water-meters." A communication. July 11, 1876.
2870.—PRESTON, F. P., PRESTIGE, J. T., and PRESTON, E. J., Deptford, Kent, "Improvements in pumps and their fittings." July 13, 1876.
2898.—PRESTON, F. P., PRESTIGE, J. T., and PRESTON, E. J., Deptford, Kent, "Improvements in apparatus for regulating and controlling the flow of water for water-closets and fire-hydrants." July 14, 1876.
2933.—STEEL, J., Glasgow, "New or improved apparatus for purifying gas." July 18, 1876.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

268.—WEBB, C. B. S., Stratford, London, "Improvements in taps and valves." Jan. 24, 1876.
281.—BRINJES, J. F., Whitechapel, London, "Improvements in apparatus for raising, forcing, and exhausting water or other liquids, also air and gases." Jan. 26, 1876.
387.—CLARK, A. M., Chancery Lane, London, "An improved method of and means for producing heat and light, and the various applications thereof." A communication. Jan. 31, 1876.
508.—NEWTON, A. V., Chancery Lane, London, "Improvements in centrifugal pumps." A communication. Feb. 8, 1876.
759.—GILLETT, J., Melksham, Wilts, "Improvements in steam-pumps." Feb. 23, 1876.
1940.—RITCHIE, C., Brixton, London, "Improvements in apparatus for utilizing heat for lighting, heating, and ventilating." May 9, 1876.
2080.—BISCHOF, G., Bloomsbury, London, "Improvements in the purification of water and sewage, and in apparatus and materials employed in connexion therewith." May 17, 1876.
2207.—LAKE, W. R., Southampton Buildings, London, "Improvements in implements for cutting pipes." A communication. May 25, 1876.

PATENTS WHICH HAVE BECOME VOID
BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

1953.—MARTIN, J. R., "An improved construction of elastic packing, more particularly applicable to rotatory engines and pumps." May 30, 1873.
2000.—BAGGS, I., "Improvements in the manufacture of gas and gases for illuminating and heating purposes, and in apparatus to be employed in connexion therewith." June 4, 1873.
2016.—LIVESEY, G. T., "Improvements in apparatus used in the manufacture of gas." June 6, 1873.
2021.—SHANKS, J., "Improvements in and connected with valves and waste preventive apparatus for water-closets, baths, lavatories, and similar apparatus." June 6, 1873.
2071.—LEIGH, J., "An improved mode of treating sewage and other contaminated waters." June 11, 1873.
2174.—LOUTTIT, K. M'L. P., "Improvements in the manufacture of gas for heating and lighting purposes, and in the apparatus employed therefor." June 21, 1873.
2209.—IMRAY, J., "Improvements in modules or apparatus for regulating and measuring the delivery of water or other liquids." June 25, 1873.
2214.—ROSS, O. C. D., M.I.C.E., "Improvements in the production of vaporized air for heating purposes generally, and in means for regulating and controlling the admixture of vaporized and other air when employed for such purposes." June 25, 1873.
2235.—BOUSFIELD, G. T., "Improvements in lamps to be used for cooking, heating, and lighting purposes." June 27, 1873.
2247.—CARTER, J. and J. E., "Improvements in the manufacture of water or stench traps." June 28, 1873.
2259.—HENDERSON, A. C., "Improvements in water, liquid, gas, and steam gauges." June 30, 1873.
2281.—CHAPMAN, L., "Improvements in rotary pumps." July 1, 1873.
2339.—GRICE, R. W., "Improvements in the manufacture of gas and coke, and apparatus connected therewith." July 5, 1873.
2342.—BONNEVILLE, H. A., "Certain improvements in fluid-meters." July 7, 1873.

PATENTS WHICH HAVE BECOME VOID
BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1352.—LIERNUR, C. T., "Improvements in the daily inodorous removal and agricultural utilization of human excrements, known as Liernur's pneumatic sewerage system." May 3, 1869.
1405.—RAMSBOTTOM, J., and PEARCE, T. M., "Improvements in steam and hydraulic apparatus for pumping, forcing, and measuring water, and for raising weights." May 7, 1869.
1810.—RIDDELL, J. H., "Improvements in joints or connexions for uniting and securing together the ends of pipes or tubes." June 12, 1869.
1931.—STILL, A. H., and LANE, D., "Improvements in the manufacture of gas." June 24, 1869.
1973.—HEYWORTH, R., "Improvements in water-closets, wash-basins, and urinals, and in self-acting apparatus for the same." June 30, 1869.
2391.—WOTHERSPOON, J., and FOULIS, W., "Improved lids or covers for retorts, and improvements in making the joint thereof with the retorts." July 11, 1873.
2404.—ROBINSON, J., "Improvements in machinery or apparatus for charging and discharging retorts, ovens, and furnaces." July 12, 1873.
2442.—KNOTT, R., "Improvements in treating sewage and other foul liquids, also partly applicable to bleaching and other cleansing operations." July 15, 1873.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

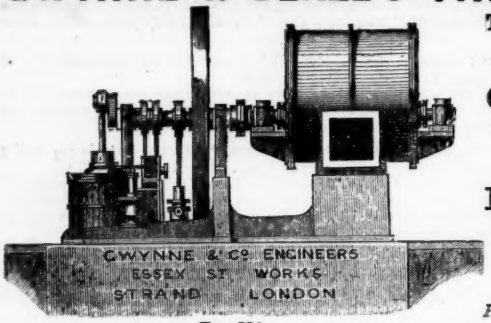


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.
HAVE MADE THE
LARGEST AND MOST PERFECT
EXHAUSTING MACHINERY
Ever produced, and the most economical in working.

Prices and every information on application.

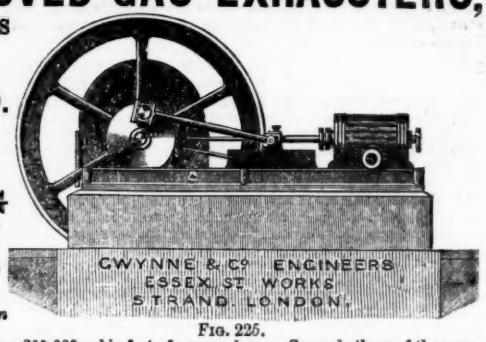
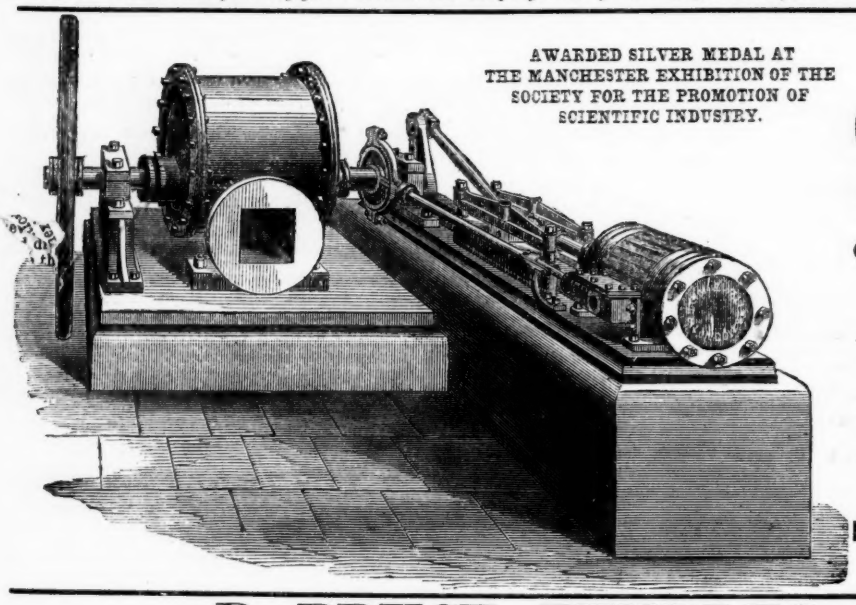


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND Co. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
CAN BE HAD ON APPLICATION TO
GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.
G. & Co. are now manufacturing for a London Gas Company three of their 210,000 *cubic feet Patent Gas Exhausters, and many of all sizes.*



AWARDED SILVER MEDAL AT THE MANCHESTER EXHIBITION OF THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY.

BEALE'S
Improved Patent
GAS-EXHAUSTERS
WITH
ENGINES COMBINED.
Sole Makers,
GEORGE WALLER & CO.

Makers of
ENGINES, EXHAUSTERS,
INDEX and DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, and other PUMPS,
SCRUBBERS and PURIFIERS,
CONDENSERS, BOILERS, &c.

PHŒNIX ENGINEERING WORKS,
HOLLAND STREET, S.E.,
AND
STROUD, GLOUCESTERSHIRE.

D. BRUCE PEEBLES & CO.,
ENGINEERS,
FOUNTAINBRIDGE WORKS, EDINBURGH,
MANUFACTURERS OF WET AND DRY GAS-METERS;
Patentees and Sole Manufacturers of PEEBLES' LAMP-GOVERNORS,
ABOVE 30,000 OF WHICH ARE NOW IN USE.

"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*

D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

WANTED, a steady, experienced Man as METER REPAIRER, Fitter, &c. State qualifications and salary required.
Apply to J. RICHMOND, Gas-Works, WORTHING.

GAS ENGINEER.

WANTED, for Foreign Works of some magnitude, a thoroughly practical and experienced ENGINEER.
Apply to ALPHA, Post-Office, Ryde, ISLE OF WIGHT.

WANTED, an experienced Man as WORKING FOREMAN at a Gas-Work where the make is about 30 million feet per annum. One who can do smith's work preferred.
Also a GAS-FITTER.
Address, stating age, references, and wages required, to No. 284, care of Mr. King, 11, Bolt Court, Fleet Street, LONDON, E.C.

BIDEFORD (DEVON) GAS AND COKE COMPANY, LIMITED.

WANTED immediately, a person who thoroughly understands Gas Engineering and the manufacture of Sulphate of Ammonia. He will be required to devote the whole of his time to the general management of the above works.
Address SECRETARY, on or before the 7th day of August, stating age, salary required, and satisfactory references.
Bideford, July 20, 1876.

CANTERBURY GAS AND WATER COMPANY.

WANTED, a second Working Engineer at the Water-Works, who will also be required to make himself generally useful. Candidates must be good mechanics, and be capable, when required, of taking charge of the pumping and other machinery.
Applications, stating age, and wages required, together with testimonials, to be addressed to me,
JAMES BURCH, Secretary.
Secretary's Office, Castle Street, July 21, 1876.

THE Advertiser, who is a practical and experienced man, requires an engagement as MANAGER of a Gas-Work. Is thoroughly conversant with the most modern appliances used in the manufacture and distribution of gas.
Address No. 283, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ADVANTAGES OF GAS FOR
COOKING AND HEATING.
HINTS ON GAS BURNERS, &c.
By MAGNUS OHREN, A.I.C.E., F.C.S.
Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

GASHOLDER MEN WANTED.—Apply to W. C. HOLMES AND CO., Whitestone Iron-Works, HUDDERSFIELD.

GAS SHARES TO BE SOLD, in a country Gas Company, incorporated by Act of Parliament.
Apply to W. L. RAMSDEN, 11, Fitzwilliam Street, HUDDERSFIELD.

FOR SALE—Station-Meter by Braddock, in perfect order, new five years ago, to pass 6000 feet per hour; 7-in. connexions. Also four PURIFIERS, 6 ft. square, hydraulic centre-valve, 7-in. connexions.
Apply to W. GUNDILL, Gas-Works, PONTEFRACT.

FOR SALE—Two of Cathels's improved four-way GAS-VALVES, of 6-inch bore. Have been in use for a short time, and are now taken down for extension of works.
Apply to the TOWN COMMISSIONERS, Ballinasloe, IRELAND.

TWO First-rate Station-Meters for Sale, to pass 80,000 cubic feet per hour. In good order, and can be made equal to new. They have just been taken down from the works of The Gaslight and Coke Company, Horseferry Road, which has now ceased to be a gas-making station.
Particulars as to price, &c., to be obtained of WILLIAM SUGG, Vincent Works, Vincent Street, WESTMINSTER, where the meters can be seen.

ON SALE—One square Station-Meter, made by West in 1866, to register 8000 feet per hour, with 8-in. valves, bye-pass, &c., now in use and in good condition.

Apply to J. AND J. BRADDOCK, Globe Meter-Works, OLDHAM.

THE Swansea Gaslight Company have for immediate SALE, the following Plant:—

A 6-h.p. Patent Trunk Engine. (Beale.)
Cylindrical Egg-ended Boiler, 30 ft. by 4 ft. 6 in. (Beale.)
Exhauster to pass 15,000 feet per hour. (Beale.)
An 8-h.p. Grasshopper Engine. (Easton and Amos.)
Cylindrical Egg-ended Boiler, 30 ft. by 4 ft. 6 in. (Easton and Amos.)
Exhauster, 20,000 ft. per hour. (Beale.)
Tar, Liquor, and Water Pumps, Eccentrics, Shafting, and Driving Pulleys.
Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.
Wrought-iron Scrubber, 5 ft. diameter, 20 ft. high.
Cast-iron Scrubber, 3 ft. diameter, 20 ft. high.
A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.

May be seen at the Gas-Works, Swansea. The whole in perfect working order; replaced by plant of larger dimensions.

Further particulars may be obtained on application to MR. THORNTON ANDREWS, SWANSEA.

BOROUGH OF BRADFORD.

TO WATER-WORKS CONTRACTORS.

THE Corporation of Bradford are pre- pared to receive TENDERS for the construction of a RESERVOIR at Upper Barden, the embankment being about 525 yards long, and 125 feet high in its deepest part, together with all its necessary bye-channels, waste water courses, tunnel, and syphon outlets; also for the construction of the Gill Beck and Lumb Gill CONDUITS, the lengths of which will be about 2143 yards and 633 yards respectively.

The drawings, sections, and specifications may be examined, and forms of tender and bills of quantities obtained, on payment of three guineas (which will be returned on receipt of a *bonâ fide* tender) from Mr. A. R. Binnie, Water-Works Engineer, Town-Hall, Bradford, between the hours of 10 a.m. and 5 p.m.

Contractors tendering should state what experience they have had in the construction of similar works.

Sealed tenders, in the form supplied by the Engineer, endorsed "Tender for Upper Barden Reservoir and Conduits," addressed to the Chairman of the Water-Works Committee, must be sent to me before 10 a.m. on Monday, the 14th of August next.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
W. T. M'GOWEN, Town-Clerk.
Town-Clerk's Office, Town-Hall, Bradford,
July 14, 1876.

TO TAR DISTILLERS.

THE Sligo Gas Company invite Offers for the surplus TAR produced at their works for the present year.

TO BE SOLD BY TENDER.—Pursuant to an order of the High Court of Justice, Chancery Division, made in the matter of the Companies Acts, 1862 and 1867, and in the matter of the Air Gaslight Company, Limited, with the approbation of the Vice-Chancellor Sir Charles Hall, TENDERS are invited to be sent to Mr. James Henry Thornton, of No. 15, Finsbury Place South, in the City of London, Public Accountant, the Official Liquidator of the above-named Company, on or before the 30th day of September, 1876, for the purchase of the PATENT and PATENT RIGHTS belonging to the above-named Company, for inventions made by Messrs. C. W. and A. H. Harrison, for the manufacture of Air Gas for Lighting and Heating Purposes, and of apparatus and machines for using the same, and comprising two patents granted in June, 1872, and for which the Company agreed to pay the sum of £100,000 in cash; and also seven subsequent patents for improvements to the said invention. Also for the purchase of the Foreign and Colonial Patents of the said Company for the countries of New Zealand, Tasmania, Victoria, Ceylon, Jamaica, British Guiana, Trinidad, Barbadoes, Dominica, Dutch West Indies, Canada, America (United States), Mexico, Brazil, Peru, Chili, Argentine Republic, Paraguay, Uruguay, United States of Columbia, Venezuela, Ecuador, Panama, Bolivia, Spain, Austria.

Particulars and conditions of Sale, and forms of tender, may be had gratis of JAMES HENRY THORNTON, of 15, FINSBURY PLACE SOUTH, E.C., the Official Liquidator; or of RICHARD HEWLETT, 36, ESSEX STREET, STRAND, W.C., Solicitor.

The Official Liquidator does not bind himself to accept the highest or any tender.

WILLIAM BINNS SMITH, Chief Clerk.

TENDERS FOR COALS.

THE Directors of the Guildford Gaslight and Coke Company are prepared to receive TENDERS for the supply of 2500 tons of Pelaw Main, Ravensworth, or New Pelton COALS, to be delivered at their works, as follows:—

300 tons	. . . . .	September, 1876.
400 ,,	. . . . .	October, ,,
400 ,,	. . . . .	November ,,
500 ,,	. . . . .	December ,,
500 ,,	. . . . .	January, 1877.
400 ,,	. . . . .	February, ,,

Equal proportions to be delivered each week in every month.

Tenders to be sent in on or before the 9th of August, 1876, endorsed "Tender for Coals," to state the name and description of Coal.

The Directors do not bind themselves to accept the lowest or any tender.

JOS. SHAW, Manager.
Guildford Gaslight and Coke Company,
Office, Gas-Works, July 21, 1876.

TO COAL MASTERS AND COAL AGENTS.

THE Directors of the Dumfries Gaslight Company are prepared to receive TENDERS for a supply of GAS COALS, from 1000 to 3000 tons, to be delivered free at the Dumfries Station, as required by the Manager.

Analysis to show at least 27 candles, combined with good coke.

Tenders to be addressed to Mr. MALAM, Gas Manager, DUMFRIES.

Gas-Works, July 14, 1876.

SALFORD CORPORATION GAS-WORKS.

THE Corporation of Salford invite TENDERS for the supply of the CANNEL and COAL required at the various Gas Stations in Salford, for One, Two, or Three years, commencing on the 1st day of September next.

Forms of tender (upon which only tenders will be received) and all particulars may be obtained on application to the Engineer, Mr. Samuel Hunter, Gas-Works, Lamb Lane, Salford.

Tenders, endorsed "Cannel and Coal Contract," to be delivered to me on or before the 28th of July, 1876.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
CHRIS. MOORHOUSE, Town-Clerk.
Town-Hall, Salford, June 29, 1876.

BRITISH ASSOCIATION OF GAS MANAGERS.

VISIT TO BECKTON, JUNE 15, 1876.

PHOTOGRAPHIC GROUPS OF MEMBERS (about 300 in each Picture), taken on the above occasion, can be had at 3s. 6d. each, post free.

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THE GAS MANAGER'S HANDBOOK,
CONSISTING OF
Tables, Rules, and Useful Information for Gas Engineers, Managers,
And others engaged in the Manufacture and Distribution of
COAL GAS.
BY THOMAS NEWBIGGING, A.I.C.E.

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SULPHATE OF AMMONIA.

WHY sell your Liquor when it pays you better to work it up yourselves?

Consult J. JUDGE, Chemical Plumber, Burner, &c., who has put up several sets for Gas Companies with success. Saturating Tanks, &c., made to order. Success sure, and nuisance got rid of.

No. 96, NEW ROAD, WANDSWORTH ROAD, S.W.

THE Vale of Neath Dinas Fire-Brick and Cement Company, Limited, Pontwalby Works, Glyn Neath, South Wales. Manufacturers of the Celebrated Genuine Dinas Fire-Bricks and Cement for Siemens's Regenerative Gas Furnaces, Bessemer Converters, Copper Smelting, Roofs of Puddling Furnaces, Glass-Works, Gas-Works, Coke Ovens, and processes involving intense and long-continued heat. Prices and estimates on application.

London Agency, 11, Queen Victoria Street, City.

PATRONIZED BY THE ROYAL ARSENAL, WOOLWICH.

FERGUSON, Builder and Contractor. Kite method of Repairing Church Spires and High Chimneys. Chimneys straightened, pointed, and hooped. Old Chimneys pulled down by a process requiring no scaffolding or stoppage of work, by competent workmen, under personal supervision. For Lightning Conductors—cheapness and method of fixing—apply to C. R. FERGUSON, 12, Canal Road, MILE END.

JOHN DEPLEDGE,
Inventor of the
DRY-FACED CENTRE-VALVE FOR PURIFIERS,
GAS AND HOT WATER ENGINEER,
20, BRIDGEHOUSES, SHEFFIELD.

CATHELS'S IMPROVED
RETORT-SETTINGS.
GUARANTEED TO HEAT UNIFORMLY WITH THE MINIMUM OF FUEL.

Coloured lithograph copies of Working Drawings of beds, of 1, 2, 3, 5, 6, and 7 Retorts each, so clearly arranged and fully shown, as to be easily understood by any retort-setter or bricklayer, having just been made of these valuable settings, they can now be supplied with detailed specifications, immediately on receipt of orders.

Applications to be made to Mr. THOS. NEWBIGGING, Gas and Consulting Engineer, 5, Norfolk Street, MANCHESTER.

JAMES MILNE & SON,
GAS ENGINEERS,
Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
EDINBURGH, AND
2, KING EDWARD STREET,
NEWGATE STREET, LONDON.

Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,
And every description of Gas-Fittings and Gas Apparatus.

B. GIBBONS, JUN.,
DIBDALE FIRE-CLAY, BRICK, AND GAS-RETORT WORKS,
STOURBRIDGE (Established 1834),
MANUFACTURER OF EVERY DESCRIPTION OF
Burs, Lumps, Stays, Shields & other Bricks, & Gas-Retorts,
A LARGE QUANTITY OF RETORTS ALWAYS IN STOCK.

Circular .	14 in.,	15 in.,	16 in.,	18 in.
Ovals . .	17 in. × 14 in.,	17 in. × 15 in.,	20 in. × 15 in.,	21 in. × 15 in., &c.
D's. . .	14 in. × 14 in.,	15 in. × 12 in.,	15 in. × 13 in.,	17 in. × 14 in., 18 in. × 13 in.
	18 in. × 15 in.,	20 in. × 16 in.,	22 in. × 14 in.,	24 in. × 14 in., 24 in. × 15 in., &c.

Special attention given to the execution of Export Orders.

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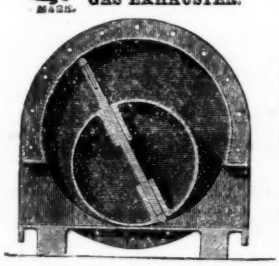

BEALE'S CONTINUOUSLY ACTING
GAS EXHAUSTERS
ARE NOW MANUFACTURED BY
B. DONKIN & CO.

MR. J. BEALE, of East Greenwich, having retired from business, has made an arrangement with B. DONKIN & CO. for the sole manufacture of his Patent Solid-Slide Gas Exhausters.

B. D. & Co. also make Steam-Engines to drive Gas Exhausters direct or otherwise, and Gas-Valves.

Estimates and Prices on application to
B. DONKIN & CO.,
ENGINEERS & IRONFOUNDERS,
55a, BLUE ANCHOR ROAD, BERMONDSEY,
LONDON, S.E.

THE NEW MODE OF BUILDING.

TO BUILDERS OR GENTLEMEN WHO WISH TO CONSTRUCT HOUSES ON THE NEW MODE OF BUILDING, ON A SIMPLE LICENCE, IN DISTRICTS NOT AT PRESENT LICENSED.

BY Recent Reductions in the cost of producing the Apparatus, I am enabled to construct and LET ON HIRE, for periods of not less than three months certain, A SET OF GEAR, consisting of a Hand Block Press, and Moulds for Slabs, and Plain Block Moulds, for 4½-in., 6-in., 9-in., and 12-in. Walls (the Blocks to be either 6 in. or 9 in. in depth, according to order, but in all cases each Block is half a yard in length), on receiving a deposit of £65; the rate charged for hire being 10s. per week for the press, and 1s. 6d. per week for each of the moulds.

Moulds for fluted or grooved Blocks will be loaned at the same rate. On returning the apparatus to the Birkenhead Station, carriage paid, the royalty of 7s. 6d. per habitable room in each house built, and for miscellaneous uses of the Blocks at 2d., 3d., or 4d. per eight Blocks or Slabs, or superficial yard of wall respectively, will be deducted, and the balance of the £65 returned. Full working wear will be allowed, but breakages must be paid for. Small wood gear can be found by the licensee, and be made at any country joiner's shop. The Blocks can be made either in winter or summer, and the minimum thick shell Blocks, with Portland cement, if it costs 80s. per ton, or with sand, bearing a cost of carriage equal to that from London to Birkenhead, these Blocks, with hydraulic lime mortar, and stones for "filling in," yield a profit in many places of 50 per cent. over brickwork, with all the appearance of the best dressed Ashlar Stones, and the walls can be made perfectly waterproof. The thin shell Blocks of "2½ to 1" concrete, with red or grey sand, are the most convenient to make in a country place. If required, a man will be sent with each machine to put it up and work it at 7s. per day, *plus* train and lodging expenses, specially to instruct in one clear day any ordinary workman in the process of making the blocks. A guarantee is given dependent on the average results of the different licensees to a limit of £100, that the buildings constructed on the new mode are superior and more stable than any system of building with bricks and mortar of the same thickness of walls; also that walls of half the usual thickness are, on this principle, sufficiently strong for many of the present building purposes. The order will be placed in course on receiving the deposit.

References: The first buildings, three-storeyed houses, built by John Tainsh, Esq., of Hamilton, N.B., the first licensee in Scotland; the buildings by other licensees now granted in England and Ireland, will be given as soon as they are sufficiently advanced. Bank reference: The National Bank of Liverpool (Birkenhead Branch).

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EXTRACT FROM THE "BRITISH DAILY MAIL," *Monday, June 5*, 1876.

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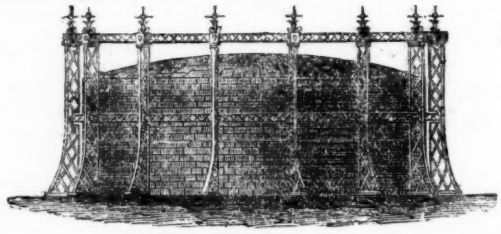

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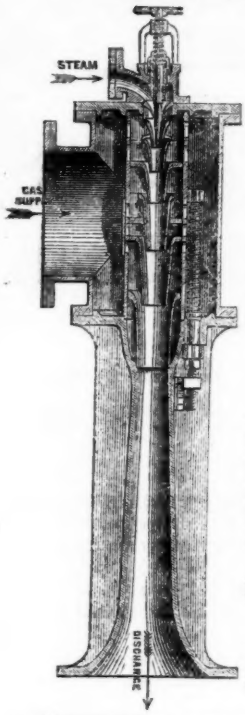

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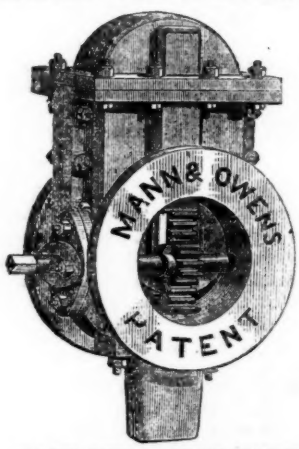

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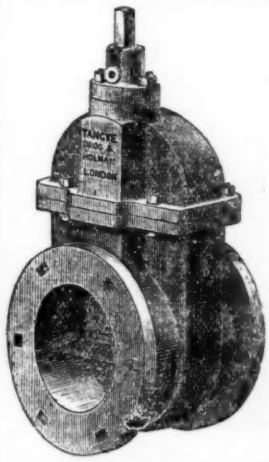

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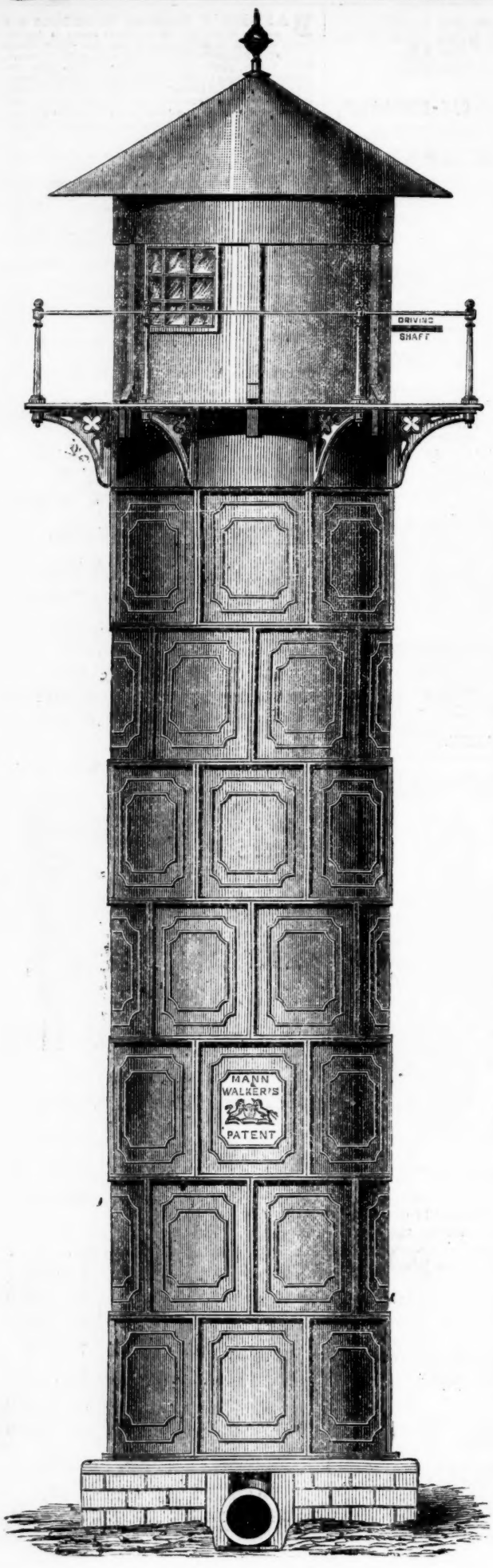

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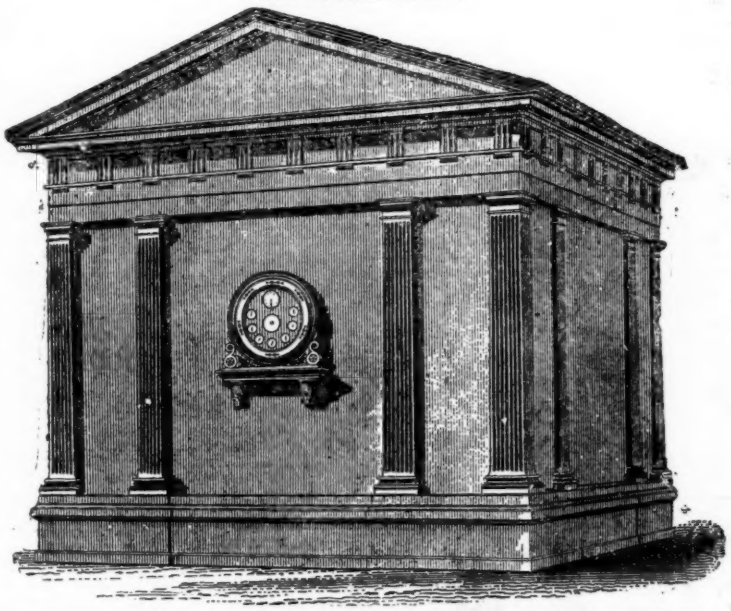

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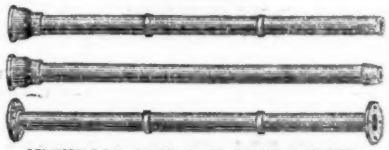

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STRONGLY RECOMMEND A TRIAL OF THEIR

CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

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JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

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GAS COAL

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Purified gas per ton of coal in cubic feet (average)	**10,775**
Weight of coke in lbs. per ton of coal	**1,465**

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

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Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: CUSTOM HOUSE CHAMBERS, LEITH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.		Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	..	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	..	34·83
Value of 1 cubic foot of gas in grains of sperm	780	..	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	..	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	..	71 minutes.
Gravity of the gas (air = 1000)	596	..	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.		Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	..	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	..	33·09
Value of 1 cubic foot of gas in grains of sperm	878	..	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	..	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	..	67 minutes.
Gravity of the gas (air = 1000)	677	..	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company.

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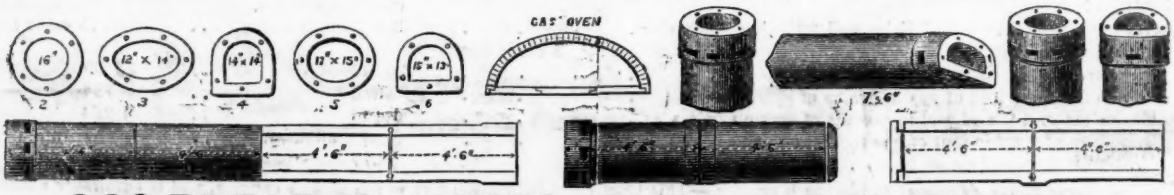

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